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Volume 15 Number 23

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December 15, 1961

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Use of funds for printing this publication has been approved by the Bureau of the Budget, July 29, 1960.

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NUCLEAR SCIENCE ABSTRACTS

GENERAL AND MISCELLANEOUS

30331 (BNL-659) NUCLEAR ENGINEERING DEPARTMENT, PROGRESS REPORT, SEPTEMBER 1–DECEMBER 31, 1960. (Brookhaven National Lab., Upton, N. Y.). May 1961. Contract [AT(30-2)-Gen-16]. 69p.

Reactor Physics. Progress is reported for various projects in reactor theory and physics. Data are given for the total neutron and activation cross sections of Dy^{164} as a function of neutron energy. Chemistry and Chemical Engineering. Some radiation research projects are reported. The yields of gas and polymer from radiolysis of C_6F_6 and C_8F_{16} were determined. High-temperature galvanic cells were used at 700 to 950°C to measure the thermodynamic properties of ThC_2. No evidence of complex formation was found in the u-v spectra of $KCl-PbCl_2$ mixtures. The effect of Na^+ ions on the extraction of Cs polyiodides from aqueous solutions containing NaI into solutions of I_2 in nitrobenzene was studied. Breakthrough curves were determined for the adsorption of Xe and Kr on activated charcoal, and the effects of temperature and gas velocity on the adsorption were studied. The I_2 adsorption isotherm on graphite was calculated for 1000°C, and several experiments were performed to test the equilibration speed of the I_2–graphite system at 1000°C. Graphite-Re thermocouples were tested at temperatures up to 2100°C, and their thermoelectric characteristics are given. Studies are reported for waste disposal by incorporation in phosphate glasses. Preliminary results are given for radiolytic product yields from aqueous NH_3, ethylene, CO_2, and U–hydrocarbon gas. Studies were performed on the removal of U from inert Al_2O_3 beds. A number of experiments were conducted on the dissolution of stainless steel-clad UO_2 and ceramic BeO–U oxide fuels in NO_2-HF in the Nitrofluor process. Teflon 100 or Teflon FEP was found to be very resistant to NO_2-HF. Liquid N_2O_4 irradiated with 5.6×10^8 r γ rays over 4 months was found to have suffered only negligible decomposition. A study was made of the vapor pressure-composition-temperature relationships of the NO_2-HF system. H_2PO_3F was found to be a good solvent for sintered ThO_2-UO_2 fuel, and the versatility of H_2PO_3F as a solvent for other fuels was studied. The diffusivity of Te in Al was determined to be $\sim 3 \times 10^{-9}$ cm^2/sec at 500°C. Meltdown experiments on U–Mo alloys indicate that I is released from the alloys independently of Te. Heat transfer rates measured on the new loop for the flow of Hg through unbaffled rod bundles and results of an analytical study of heat transfer to liquid metals flowing in concentric annuli are reported. Hot Laboratory. Progress is reported on production of Ca^{47}, I^{124}, Ar^{38}, Ga^{68}, Mg^{28}, Li^6D, I^{132}, and Sc^{48}. Experiments on the effects of tri-n-octylamine on the extraction of Th by thenoyltrifluoroacetone are reported. The standard potentials of four metal ion–metal systems in a sulfate eutectic were determined. Electrochemical studies of fused salts are reported. Other aspects of the hot laboratory operation, e.g., radioisotope production and wastes, are discussed. Metallurgy. The operation of loops and capsules for testing materials in liquid metals is described. Pure Fe was obtained by vacuum melting in an Al_2O_3 crucible in a Ta-gettered furnace. Heating to 800°C for 30 hr resulted in complete removal of entrapped Xe from irradiated UBi_2 dispersed in Bi. The thin liquid film technique combined with mechanical polishing was successful in depositing uniform Zr films of reproducible thickness on $2\frac{1}{4}$ Cr–1 Mo steel surfaces from liquid Bi–Zr alloys. The solubilities of Al and Lu in liquid Bi were determined. A partition function is presented for liquid metallic solutions that form no solid solutions or intermetallic compounds. The operation of the Brookhaven Graphite Research Reactor Radiation Loop is discussed briefly. Radiation effects on the low-temperature properties of pure Fe were studied. The stored energy in the Medical Research Reactor graphite was measured. The growth and recovery of the Graphite Research Reactor graphite after the 14th and 15th anneals are reported. Surface area measurements are reported for Al_2O_3, UO_2, and UC powders. Mechanical Engineering. Various projects are described briefly, such as the HFBR, loops, and reactor evaluation. (D.L.C.)

30332 (NP-10734) THIRD REPORT TO THE CONSULTATIVE ASSEMBLY OF THE COUNCIL OF EUROPE ON THE ACTIVITIES OF THE EUROPEAN NUCLEAR ENERGY AGENCY. (Organization for European Economic Co-Operation, Paris). Sept. 1961. 253p.

Activities of the European Nuclear Energy Agency (ENEA) are described. Progress is reported on the Eurochemic Company for processing irradiated fuels, the Halden and Dragon reactor projects, nuclear ship propulsion study, steps toward closer international scientific cooperation, establishment of liability for damage following nuclear accidents, and other developments toward uniform atomic regulations in Europe. (M.C.G.)

30333 (NP-10812) ASTRONAUTICS INFORMATION. Abstracts Vol. IV, No. 3. Abstracts 4,202-4,321. B. J. Hardgrove, E. H. Sands, and F. L. Warren, comps. (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Sept. 1961. NASw-6. 51p.

This bibliography contains 119 selected references on the subject of space flight and applicable data and tech-

niques. Author, subject, and source indexes are included. (C.H.)

30334 (SC-4483(RR)) HIGH-EXPLOSIVE DITCHING FROM LINEAR CHARGES. Final Report, November 1959–June 1960. R. H. Carlson (Sandia Corp., Albuquerque, N. Mex.). July 1961. Project: TOBOGGAN. 124p.

Weights of linear high-explosive charges fired on the Yucca Lake playa of the Nevada Test Site varied from 0.23 to 42.7 pounds per foot. Crater and ditch dimensions and volumes resulting from these shots, fired during the fall of 1959 and spring of 1960, are presented as a function of charge burst depths. Scaling relationships determined were as expected; i.e., square-root scaling of linear-charge weight per foot for ditch width and depth and a direct linear-charge weight relationship to ditch volume were obtained. Permanent ground surface displacement varied as the −3.22 power of the scaled distance from the charge. Detonation effects, charge shape effects, ditch erosion, and ditch cross sections are discussed. The appendixes present Toboggan data, results of soils investigation, and mathematical treatment given the data. (auth)

30335 (STI/DOC/10/3) PROSPECTS OF NUCLEAR POWER IN THE PHILIPPINES. Technical Reports Series No. 3. (International Atomic Energy Agency, Vienna). Aug. 1961. 108p.

An analysis of the prospects of utilizing advantageously a relatively large-sized nuclear power plant in the Luzon Grid in the late 1960's is presented. Also included are a review of the alternative energy resources of the Philippines, an evaluation of the projections of power demand and of the supply program for the Luzon Grid, and the necessary steps to be taken for the possible introduction of nuclear power. The cost comparisons indicated that a nuclear power station of 2 × 100 Mw units installed in the Manila area in 1967 and 68 might be competitive over its lifetime with an oil-fired station of the same size. (M.C.G.)

30336 (AEC-tr-4516) GAMMA-RADIATION OF AN ATOMIC EXPLOSION. O. I. Leipunskii. Translation of "Gamma-Izluchenie Atomnogo Vzryva" (a publication of the State Committee of the Council of Ministers of the U.S.S.R. on the Utilization of Atomic Energy, Moscow, 1959). 167p.

The physics of the action of gamma radiation in atomic explosions is discussed. The dose of gamma radiation was estimated and the physical factors which influence its magnitude were analyzed. The analysis was based on the results of the theory of multiple scattering of gamma quanta. The calculations of doses were based on explosion energies of 20 megatons. Main sources of gamma radiation in atomic explosions and propagation of gamma radiation in absorbing media are discussed. (M.C.G.)

30337 (AEC-tr-4616) SWEDISH BILL ON THE CIVIL LIABILITY IN THE FIELD OF NUCLEAR ENERGY (OCTOBER 1, 1959). Translated from report number CNTr-3 of the Comitato Nazionale per le Ricerche Nucleari, Italy, March 1960. 10p.

A bill which delineates the governmental responsibilities in the area of nuclear energy is presented. The law is to be in force during the period July 1, 1960 to January 1, 1964. (J.R.D.)

30338 (AEC-tr-4617) DECREE ON PROTECTION AGAINST IONIZING RADIATIONS (NETHERLANDS, MARCH 20, 1957). Translated from report number CNTr-9 of the Comitato Nazionale per le Ricerche Nucleari, Italy, March 1960. 25p.

A decree related to control and governmental responbilities in the area of ionizing radiations in the Netherlands is presented. The decree became effective on March 20, 1957. (J.R.D.)

30339 (AWRE/Trans/23) MECHANISM OF INITIATION OF DETONATION IN EXPLOSIVES. K. K. Andreev. Translated by F. E. Wallwork (United Kingdom Atomic Energy Authority Atomic Weapons Research Establishment, Aldermaston, Berks, England) from Izvest. Akad. Nauk S. S. S. R., Otdel. Tekh. Nauk Energet. i Avtomat., No. 4, 188-97(1959). 19p.

A survey was made of ways of exciting detonation in explosives, including development of detonation from deflagration under various conditions, from transmitted detonation, and from the action of shock on the explosive. The fundamental cause of the development of detonation appears to be the sharp increase in pressure arising from the formation and explosion of a burning suspension of explosive in the gaseous products of combustion. The various possibilities for the formation of a suspension of this type are discussed. (B.O.G.)

30340 DIRECT THRUST AND EFFICIENCY MEASUREMENTS OF A CONTINUOUS PLASMA ACCELERATOR. Sterge T. Demetriades and Richard W. Ziemer (Norair Div., Northrop Corp., Hawthorne, Calif.). ARS (Am. Rocket Soc.) J., 31: 1278-80(Sept. 1961).

Experiments were performed with a continuous Lorentz or J × B accelerator, using an arc jet plasma source and argon and nitrogen expellants. At flow rates of 0.003 lb/sec, directly measured thrusts of up to 3.6 lbf, exclusive of the arc jet, were obtained, with acceleration efficiencies as high as 54%. The specific impulse increment due to the plasma accelerator was 1200 sec corresponding to an addition of 300% to the specific impulse of the arc jet used in these experiments. (auth)

30341 KERNENERGIE. VORTRÄGE, GEHALTEN ANLÄSSLICH DER STUDIENTAGUNG FÜR KERNENERGIE VOM 24., 25. UND 26. MÄRZ 1960 IN ZÜRICH. (Nuclear Energy. Papers Presented on the Occasion of the Conference on Nuclear Energy on March 24, 25, and 26, 1960 in Zurich). "Die blaue "TR" Reihe" No. 30 from Tech. Rundschau, Nos. 25, 28, 30-2, 34, 36, 40-2, 44, 46-9, 1960. Bern, Hallwag A. G., [1960]. 142p.

The texts of 16 papers presented at the conference are reproduced here. The topics encompassed the field of nuclear energy from elementary nuclear physics and uranium production to reactor safety and costs and the second generation problems. Separate abstracts were prepared for all but 5 of the papers which were of an elementary or non-technical nature. (T.R.H.)

30342 URANIUM OCCURRENCE AND URANIUM RECOVERY. Th. Hügi (Universität, Bern). p.21-7 of "Kernenergie." Bern, Hallwag A. G., [1960]. (In German)

As an introduction to a brief survey of U occurrence in Canada, South Africa, USA, Germany, and other countries, the mineralogy and geochemistry of U is discussed. The methods used for the recovery of the metal from its ores are indicated. (J.S.R.)

30343 SURVEY OF THE CONSTRUCTION OF POWER REACTORS. Werner R. Dubs (Escher Wyss A. G., Zurich). p.29-47 of "Kernenergie." Bern, Hallwag A. G., [1960]. (In German)

The constituent parts of power reactors and their function are briefly reviewed. The individual reactor types are then discussed. The homogeneous reactor, heterogeneous reactor, pressurized water reactor, organic-cooled and moderated reactor, boiling water reactor, gas-cooled reactor, and fast breeder reactor are described. (J.S.R.)

30344 PROBLEMS IN PLUTONIUM PRODUCTION AT MARCOULE AND THEIR SOLUTION. R. M. Galley (Commissariat à l'Energie Atomique, Paris). p.49-56 of "Kernenergie." Bern, Hallwag A. G., [1960]. (In German)

The pilot plant built at Marcoule for Pu production is briefly described, and the principal problems in its operation are indicated. The chemical processes—dissolution, uranium extraction and concentration, Pu concentration, Pu purification, and concentration of fission products—are described with the aid of flow diagrams. (J.S.R.)

30345 POWER REACTOR PROJECTS IN SWITZERLAND. W. Winkler and J. Brunner. p.65-73 of "Kernenergie." Bern, Hallwag A. G., [1960]. (In German)

Power reactor projects in Switzerland are financed by private industry. The reactors being constructed by two of these industrial groups—Konsortium and ENUSA—are described. The ENUSA reactor is of the BWR type and the Konsortium reactor is of the PWR type. Cross sections of the reactors are given and discussed. (J.S.R.)

30346 FISSION MATERIALS AND PREPARATION; METALLURGY OF URANIUM. R. Rometsch (Forschungsabteilung der Eurochemic, Mol, Belg.). p.75-9 of "Kernenergie." Bern, Hallwag A. G., [1960]. (In German)

A discussion of the properties of natural uranium as a fuel leads to a review of the problems of uranium metallurgy and fission product regeneration and to a comparison of fuel cycles. (J.S.R.)

30347 FUEL ELEMENTS. Peter Sulzer (Gebr. Sulzer A. G., Winterhur, Switzerland). p.81-7 of "Kernenergie." Bern, Hallwag A. G., [1960]. (In German)

Reactor fuel elements can be fabricated of uranium metal or its alloys, ceramic materials, or fissionable materials dispersed in a metallic matrix. These types of fuel elements and their fabrication and cladding are briefly reviewed. (J.S.R.)

30348 MATERIAL PROBLEMS IN REACTOR CONSTRUCTION. W. Epprecht (ETH, Zurich). p.89-93 of "Kernenergie." Bern, Hallwag A. G., [1960]. (In German)

Problems encountered in the construction of reactors are outlined, and the special nature of these problems are illustrated with examples. Only core construction for thermal reactors is considered. (J.S.R.)

30349 MECHANICAL ENGINEERING PART OF REACTOR PLANTS. W. Traupel (ETH, Zurich). p.95-104 of "Kernenergie." Bern, Hallwag A. G., [1960]. (In German)

The mechanical engineering part of a reactor plant consists not only of the steam or gas turbines but also auxiliary equipment. The auxiliary equipment often presents special problems as the operating conditions of the reactor affect the equipment directly. The problems are related to the necessity for special construction to prevent the leak of radioactive materials into turbines and to the high operating temperature of some reactors. These problems are discussed first with respect to the turbines, and then the auxiliary equipment is considered. (J.S.R.)

30350 CONTROL TECHNIQUES AND SAFETY DEVICES IN NUCLEAR POWER PLANTS. J. Kägi (Gebr. Sulzer A. G., Winterthur, Switzerland). p.105-15 of "Kernenergie." Bern, Hallwag A. G., [1960]. (In German)

The basic requirement of control in a power plant consists in the transmission of the energy produced at the requirement of the user while operation magnitudes such as temperature and pressure remain within a given range. The principles for control and safety devices are the same for nuclear power plants as for fossil fueled plants, but the requirements on operational security are much higher. The control and safety devices used in a reactor are discussed from the viewpoint of their differences from the conventional systems used in fossil-burning power plants. (J.S.R.)

30351 SOME ASPECTS OF REACTOR SAFETY. A. F. Fritzsche (Institut fur Reaktorforschung, Würenlingen, Switzerland). p.117-28 of "Kernenergie." Bern, Hallwag A. G., [1960]. (In German)

General aspects of reactor safety are discussed after a review of the possible dangers inherent in reactor operation. The safety of a reactor installation depends essentially on three factors: inherent safety of a given reactor type, construction safety measures, and safety in the operational techniques. Each of these is discussed and examples are given. (J.S.R.)

30352 CONSTRUCTION COSTS AND ENERGY PRICE IN NUCLEAR POWER PLANTS. André Gardel. p.129-34 of "Kernenergie." Bern, Hallwag A. G., [1960]. (In German)

In calculating the construction costs of a reactor the synthetic method or the analytical method may be used. These two methods are briefly illustrated. The yearly operational costs depends on the capital cost, the maintenance and regeneration costs, the general expenses, and the fuel consumption. After the yearly operations are established, the kwh price depends on the energy produced. Studies made on these prices are reviewed. (J.S.R.)

BIOLOGY AND MEDICINE

General and Miscellaneous

30353 (A/AC.82/G/L-288) RADIOACTIVE MATERIALS IN FOOD AND AGRICULTURE. Report of an FAO Expert Committee, November 30–December 11, 1959, Rome. (Food and Agriculture Organization of the United Nations, Rome). [Jan. 6, 1960]. 114p.

A summary is presented of conclusions and recommendations of the Food and Agriculture Organization Committee of the United Nations on radioactive contamination of the food chain in terms of food, agricultural, and fisheries experience and knowledge. More detailed information is included in appendices. (J.R.D.)

30354 (STI/DOC/10/4) IAEA RESEARCH CONTRACTS FIRST ANNUAL REPORT. Technical Reports Series No. 4. (International Atomic Energy Agency, Vienna). 1961. 31p.

Summaries are included of research contracts which expired prior to Dec. 31, 1960. The contracts were concerned with investigations of: electrophysiological responses of biological systems in nerve cells to irradiation with small doses of ionizing radiations; the mode of the protective action of certain sulfhydryl compounds against radiation effects on the synthesis of deoxyribonucleic acid, using tritium-labeled thymidine; development of a bubble chamber method of monitoring and dosimetry for low fast neutron fluxes; effects of incorporated radioisotopes on the stability of genetic materials; interrelation of root and leaf absorption of radioisotopes in herbaceous plants; uptake of radioactive wastes by lowland rice from soils contaminated by irrigation water, and decontamination of the rice; and comparison between mutation rates induced by acute and chronic gamma irradiations. (B.O.G.)

30355 (TID-13030) ANNUAL REPORT [ON BIOCHEMISTRY] AND REQUEST FOR RENEWAL [OF CONTRACT], SEPTEMBER 15, 1960–SEPTEMBER 14, 1961. Roger M. Herriott (Johns Hopkins Univ., Baltimore. School of Hygiene and Public Health). Contract AT(30-1)-1371. 38p.

An analysis was made of the mechanism of heterozygote formation by slow cooling of DNAs heated to 100°C. The properties of three general types of genetic loci for a given phenotype are described and a method given for detecting each type. The genotype of an isolated mutant of H. influenzae resistant to 700 μg/ml of streptomycin was analyzed. A protoporphoryin utilizing mutant was isolated which does not appear to utilize hemin. Inactivation of the "recombining elements" of transforming DNA by ultraviolet radiation was investigated. A study was made of an operator gene and control of genetic functions involving complimentation between phages, all of which were defective and could not form phage or cause the cells to lyse. Sublethal ultraviolet lesions in DNA following in vivo exposure were detected. The energy of white light that causes the U. V. DNA enzyme complex to break up was estimated directly to be a quantum yield greater than 10^{-2}. Purification of yeast photoreactivating enzyme was obtained using ammonium sulfate fractionation followed by chromatography. (M.C.G.)

30356 (TID-13783) RADIOISOTOPE EXCHANGE STUDIES IN LAKES. Progress Report [Covering Contract Period] January 1961–December 1961. (Wisconsin. Univ., Madison). Contract AT(11-1)-64. 84p.

Investigations were made of the exchange of elements across the chemocline of a meromictic lake, ionic transport in an ice-covered lake, biological transport of radionuclides in a meromictic lake, summer aeration of a small lake, the influence of aeration additions on the plankton of a dystrophic lake, and productivity measurements before and after treatment with anhydrous ammonia in a small dystrophic lake. (M.C.G.)

30357 (UCD-103) DEVELOPMENT OF THE OVARY IN THE BEAGLE. A. C. Andersen and M. E. Simpson (California. Univ., Davis. School of Veterinary Medicine). Project [Title]: THE EFFECTS OF X-RADIATION ON WORK CAPACITY AND LONGEVITY OF THE DOG. Aug. 1961. Contract AT(11-1)-GEN-10. 20p.

The development of the ovary of the dog was studied in an attempt to explain the response to irradiation. Material is presented photographically to show gonadal changes with age in the beagle. Fetal implantation occurs 18 to 20 days after conception; hence, development studies of the ovary have been confined to the 2nd and 3rd trimester periods. Fetal development begins during the second trimester and the gestation period is 60 days. (auth)

30358 INCORPORATION OF I^{131} INTO CHICKEN EGGS. J. Okonski, F. W. Lengemann, and C. L. Comar (Cornell Univ., Ithaca, N. Y.). Health Phys., 6: 27-31(Aug. 1961).

After the Windscale accident surveys showed eggs to be the greatest source of I^{131} next to milk. Since little information is available, experiments were carried out to provide background information on the accumulation of I^{131} in eggs. When hens received daily oral doses of I^{131} the eggs showed a plateau level of about 8 per cent of a daily dose at 6 days after the start of the experiment. Most of the I^{131} was located in the yolk, presumably in the ionic form though a significant amount may be protein bound. With a single dose of I^{131} the maximum amount in the eggs was reached on the sixth day after dosing and indicated that maximum hazard would show a time lag. (auth)

30359 A SIMULATOR FOR γ-RAY EXPOSURE FROM NUCLEAR FALLOUT. D. G. Baker, J. C. F. MacDonald, and C. G. Hunter (Univ. of Toronto). Health Phys., 6: 41-5(Aug. 1961).

A device is described by which laboratory animals may be irradiated at dose rates which are varying in a way similar to those from the γ-radiation from radioactive fall-out. The animals are moved relative to a fixed source of Co^{60} in such a way that the dose-rate to which the animals are exposed varies as a power function of time. Experimental verification of the theory of the device is presented. A method of achieving a range of total exposure doses in a particular time interval is described. The $LD_{50/30}$ for mice exposed to simulated fall-out of 96 hr duration was 1109 r compared to 1008 r when the dose was delivered at a constant dose rate over the same time interval, or 553 r when it was delivered at 65/min using a 250 kv x-ray source. (auth)

30360 DISPERSION OF RADIOCONTAMINANTS IN AN ESTUARY. F. L. Parker, G. D. Schmidt, W. B. Cottrell, and L. A. Mann (Oak Ridge National Lab., Tenn.). Health Phys., 6: 66-85(Aug. 1961).

The dispersion of radioactive contaminants in an estuary is more complex than the dispersion in a flowing freshwater stream due to tidal cycling in the estuary. Many approximate, analytical solutions are available for the hydraulic dispersion, but a model study is more accurate.

The model study, however, ignores radioactive decay, and the absorption and adsorption of the nuclides by the sediments and the biota. An evaluation of the maximum credible accident to the NS Savannah during start-up in the Delaware River shows that hazardous conditions will not exist. The evaluation is based on model studies by the U. S. Army Engineer Waterways Experiment Station and includes the nuclear decay and sorption of the nuclides. The maximum credible accident assumes 600 days operation at 69 MW and that 100% of the fuel rods fail. It is also assumed that only a percentage of the isotopes will escape from the containment vessel, at a leakage rate of 0.2% of the free volume of the containment vessel per day. Exposures from swimming and boating in the water and drinking the water from the river are evaluated. The maximum hazard occurs during the few days that the maximum concentration in the river water is about twice the maximum permissible concentration for continuous occupational exposure. (auth)

30361 THE LOCALISATION OF BRAIN TUMOURS BY MEANS OF RADIO-ISOTOPES. [PART] I. F. Mundinger (Neurosurgical University Clinic, Freiburg i. B.). Medicamundi, 7: 61-6(1961). (In English)

The general conditions are discussed with which radioactive nuclides used in brain tumor localization must comply. The intra-operative localization method is described, in which measuring is performed by needle-shaped counter tubes or scintillation counters, which in the form of puncture needles with a diameter of 2–3 mm are introduced into the brain during the operation. For this application beta emitters are used with a small radiation range. The nuclides used for this are discussed. (auth)

30362 EXPERIMENT ON THE USE OF GRIDS IN FAST ELECTRON THERAPY. VARIATIONS OF THE DOSE DISTRIBUTION WITH RESPECT TO THE APERTURES. C. Bompiani (Università, Rome) and A. V. del Vescovo. Nuntius Radiol., 27: 270-5(Apr. 1961). (In Italian)

Research has been carried out to evaluate possible differences of the dose distribution under two grids with the same aperture ratio but with holes of different size. The results show that the only effective variation, at least with respect to the experimental grids, consists in the depth of the homogenization plane and therefore of the position, within the absorbent means, of the volume of homogeneous irradiation. (auth)

30363 EXTERNAL COLLIMATION DETECTION OF INTRACRANIAL NEOPLASIA WITH UNSTABLE NUCLIDES. G. M. Shy, R. B. Bradley, and W. D. Matthews, Jr. With a Chapter on Scintillation Spectrometry. J. E. Francis, P. R. Bell, and C. C. Harris. Edinburgh and London, E. & S. Livingstone Ltd., 1958. 148p.

The principles of collimation as a means of retaining resolution with large sensitive detectors are described. Highly sensitive volume collimators are designed and utilized as optimal in this study. A dual rectilinear scanner capable of carrying two such collimators with their associated shielding is described. Various methods of recording the intracranial activity are demonstrated. The principles of gamma spectrometry are emphasized. The differences between lead and gold collimators are statistically demonstrated. The normal scan of the head is discussed. Abnormal scans are declared confirmed if the following criteria are satisfied: in the case of neoplasia within the brain, or the coverings of the brain, such abnormality must be seen at operation or upon post-mortem; in the case of metastatic neoplasia to the bone, such abnormality must be confirmed by erosion in the x ray; in major vascular incidences to the brain, subsequent atrophy confirmed by pneumoencephalography should be demonstrated. Negative scans are declared confirmed only if operated upon by the surgeon and found to be negative, or if found to be negative at post-mortem examination. The percentage accuracy of confirmed scans indicates that this technique approaches the usefulness of air contrast studies. Three advantages are: it minimizes hazard to the patient and disturbance to intracranial pressure; it indicates to the surgeon the size of the lesion; and it may indicate multiplicity of lesions. (N.W.R.)

30364 ISOTOPEN-UND STRAHLENFIBEL FÜR DEN ARZT. (Isotope and Radiation Primer for the Doctor). Walter Beier and Erich Dörner. Leipzig, Veb Georg Thieme, 1960. 269p.

The purpose of the present book is to bring to the doctor in general practice the fundamentals of the application of radioisotopes by means of some selected examples, tables, and pictures. The topics discussed include radioisotopes as medical radiation sources, radiation detection, interaction between radiation and matter, dose measurements of radioisotopes, the present radiation burden of man, radiation dangers for man, important radiation damage, radiation protection, possibilities for utilization of radioisotopes in biology and medicine, and the important radioisotopes used in biology and medicine. A glossary gives the definitions of many of the phrases used in radiomedicine. (J.S.R.)

30365 RADIOAKTIVE ISOTOPE IN KLINIK UND FORSCHUNG. Band IV. Vorträge am Gasteiner Internationalen Symposion 1960. (Radioactive Isotopes in the Clinic and in Research. Volume IV. Proceedings of the Gastein International Symposium, 1960). K. Fellinger and R. Höfer, eds. Munich-Berlin, Urban & Schwarzenberg, 1960. 393p.

Thirty four papers and the discussions following each are compiled. The papers were limited to the following subjects: (1) investigations of calcium metabolism and the location of bone tumors with Ca and Sr isotopes; (2) new methods of therapy with radioactive isotopes; (3) investigations on the structure of erythrocytes by in vivo measurements; (4) determination of the electrolyte content of the body and electrolyte exchange, as well as determinations of the total body and extracellular waters; (5) investigations of glucose and insulin metabolism by means of radioisotopes; and (6) the peripheral metabolism of thyroid hormones and iodated amino acids. (J.S.R.)

30366 MATHEMATICAL ANALYSIS OF TRACER DATA IN CALCIUM AND STRONTIUM STUDIES. G. L. Brownell, E. Greenfield, and P. Brentani (Massachusetts General Hospital, Boston). p.1-11 of "Radioaktive Isotope in Klinik und Forschung. Band IV." Munich-Berlin, Urban & Schwarzenberg, 1960. (In English)

Many models of calcium and strontium metabolism suggest the presence of exponential terms in specific activity curves. The analog computer is of value in analyzing such curves in cases where many compartments may be observed and the curves have characteristic shapes. Digital methods appear to have considerable use in cases where a single compartment may be observed and the resultant curve consists of a series of decreasing exponentials. Although curve peeling may be performed by simple mathematical procedures, more complex analysis requires machine computation. Several transforms appear to have value in the analysis of such curves. A number of factors involved in the use of these transforms were studied. A machine program for least square curve fitting to a sum of exponentials is now being developed. (auth)

30367 THE USE OF AN ION-EXCHANGE COLUMN FOR THE STUDY OF STRONTIUM AND CALCIUM METABOLISM. W. B. Looney (Massachusetts General Hospital, Boston and Harvard Medical School, Boston), C. J. Maletskos, M. Helmick, J. Reardan, J. Cohen, J. Buchanan, F. I. Visalli, J. Merrill, and W. Guild. p.12-18 of "Radioaktive Isotope in Klinik und Forschung. Band IV." Munich-Berlin, Urban & Schwarzenberg, 1960. (In English)

Circulation of the blood of dogs through a cation-exchange column has proved to be an effective method for removing stable calcium and the radioisotopes of strontium and calcium from the blood. It is considered that the cation-exchange column is a satisfactory method for the study of strontium and calcium metabolism under non-equilibrium conditions. (auth)

30368 TOTAL BODY COUNTING OF CALCIUM-47. M. G. Rinsler, G. M. Dyche, and N. G. Trott (Royal Cancer Hospital, London). p.19-28 of "Radioaktive Isotope in Klinik und Forschung. Band IV." Munich-Berlin, Urban & Schwarzenberg, 1960. (In English)

A body counter consisting of 8 GM counters, screened with lead cylinders 1.3 cm thick, was used to study the activity of Ca^{47} remaining in patients after intravenous administration. A comparison was made between the results obtained by this method and by determination of the cumulative loss of activity in excreta, using administered activities of 40 to 50 μc. Differences noted in the results obtained by the two techniques are discussed. An account is also given of measurements carried out using low background scintillation counting equipment. Satisfactory measurements could be made for up to 15 days after injection using about 50 μc for the GM counter system and less than 0.5 μc with the low background scintillation counter. (auth)

30369 IN VITRO AND IN VIVO STUDIES WITH BONE-SEEKING ISOTOPES. M. Bluhm, J. MacGregor, and B. E. C. Nordin (Gardiner Inst., Western Infirmary, Glasgow). p.29-36 of "Radioaktive Isotope in Klinik und Forschung. Band IV." Munich-Berlin, Urban & Schwarzenberg, 1960. (In English)

The techniques pioneered by Bauer and his associates on the calculation of bone accretion rate with bone-seeking isotopes is generally accepted. However, there are two curious features of the results obtained. One is the high correlation between the exchangeable calcium pool and the accretion rate. The other is that although the fall in specific activity in the tissue fluids is exponential, the rate of fall changes after about 10 days, when it becomes less rapid. To investigate the causes for these anomalies, in vivo and in vitro studies were made. The exponential fall in the specific activity of the excreta of subjects receiving Ca^{47} was calculated in the usual way. The in vitro observations were made with the bone system, which consisted of bone fragments of various sizes in cellophane bags equilibrated with buffer solutions. Ca^{45}, Ca^{47}, Sr^{85}, Sr^{90}, or P^{32} was added to the system at chemical equilibrium and the equilibrium process observed for several weeks at a constant pH. From the results it was suggested that the fall in specific activity in tissue fluids which is observed in vivo over the first 10 days includes a component of diffusion into the deeper mineral in the skeleton, and that the magnitude of this component is a function of the change which is seen in the rate of fall at about 10 days. (J.S.R.)

30370 A STUDY OF THE DISTRIBUTION OF Ca^{45} AS A FUNCTION OF TIME IN THE NEW-BORN RAT BY AUTORADIOGRAPHY AT LOW TEMPERATURES. C. Kellershohn and P. Pellerin (Institut National d'Hygiène, Chatillon-Sous-Bagneux-Seine, France). p.37-44 of "Radioaktive Isotope in Klinik und Forschung. Band IV." Munich-Berlin, Urban & Schwarzenberg, 1960. (In French)

The method of autoradiography at low temperature permits the study in a simple manner of the distribution of Ca^{45}, in space and time, in the new-born rat. The study has shown the existence of a rapidly changeable osseous calcium fraction. There is a considerable intestinal excretion of the radiocalcium, much higher than the urinary excretion. A progressive transfer of the activity occurs for the long bones of the epiphysic regions to the diaphysic regions during growth. Secondary change also occurs during the ossification. (tr-auth)

30371 TRACER STUDIES OF BONE METABOLISM IN MAN USING STABLE STRONTIUM AND Ca^{47}. R. Fraser, M. Harrison, and E. Jones (Postgraduate Medical School, London). p.45-9 of "Radioaktive Isotope In Klinik und Forschung. Band IV." Munich-Berlin, Urban & Schwarzenberg, 1960. (In English)

The utilization of stable strontium isotopes as a tracer for calcium metabolism in man is discussed. A test was made to show that the strontium tracer test does faithfully reflect calcium metabolism. The Sr test has proved of value in the diagnosis of metabolic bone disease. It was found that of all hypercalcemic states tested, only hyperparathyroidism is characterized by an abnormally rapid rate of deposition of Ca in bone as measured by the Sr test. In patients with steatorrhoea, the Sr test reveals an abnormally high rate of bone deposition in all cases. A normal rate of bone formation is found in osteoporosis. (J.S.R.)

30372 STRONTIUM AND CALCIUM METABOLISM IN PARATHYROID AND THYROID DISORDERS, OSTEOPOROSIS, AND PAGET'S DISEASE. E. C. Dow, J. B. Stansbury, and G. L. Brownell (Massachusetts General Hospital, Boston). p.50-60 of "Radioaktive Isotope in Klinik und Forschung. Band IV." Munich-Berlin, Urban & Schwarzenberg, 1960. (In English)

Patients with parathyroid and thyroid disorders, osteoporosis, and Paget's disease were given intravenously a simultaneous injection of Ca^{45} and Sr^{85}. Metabolic balance indicated that in all cases and at all times the body retention of Ca^{45} exceeded that of Sr^{85} retention. Calcium "pools" and compartment sizes as determined by either isotope proved to be sensitive indices of skeletal function. The largest values were found in Paget's disease and thyrotoxicosis and the lowest in myxedema. Cortisone in usual therapeutic dosage failed to suppress completely the activity of Paget's disease as measured by Ca^{45} dynamics. Prolonged estrogen therapy in one patient with osteoporosis of the postmenopausal type effected no change in skeletal dynamics. External body surface counting indicated that Sr^{85} uptakes were highest and most sustained in Paget's disease and thyrotoxicosis and lowest in myxedema and active osteoporosis. Sr^{85} qualitatively parallels Ca^{45} as an index of skeletal function in metabolic bone diseases. (auth)

30373 DIAGNOSTIC IMPORTANCE OF STRONTIUM-85. R. A. Guerin and M. T. Guerin (Institut National d'Hygiene, Paris). p.61-72 of "Radioaktive Isotope in Klinik und Forschung. Band IV." Munich-Berlin, Urban & Schwarzenberg, 1960. (In French)

The diagnostic importance of Sr^{85} is reviewed. It is shown that external measurements of Sr^{85} uptake by the bone are often very useful to the physician. These measurements are of great value in the discussion of the benign or malign nature of the lesion explored. They furnish new data on the actual extension of tumors and on their evolu-

tionary potential. The discovery of unrecognized metastatic lesions can be performed with Sr^{85} measurements. The exploration of the squelette by Sr^{85} appears however insufficient if it is not completed by the study of the distribution velocity of the isotope of the serum and by the tracing of urinary elimination curves. (tr-auth)

30374 TISSULAR DISTRIBUTION AND PLACENTAL TRANSFER OF STRONTIUM-90 IN PREGNANT GUINEA PIG. J. Sternberg (Univ. of Montreal). p.73-92 of "Radioaktive Isotope in Klinik und Forschung. Band IV." Munich-Berlin, Urban & Schwarzenberg, 1960. (In English)

Pregnant guinea pigs have the same absorption and excretion rate as non-pregnant adult animals; the urinary excretion is diminished in late pregnancy. The absorption of Sr^{90} is regulated both at the digestive cell and at the renal level, according to the route of administration of the isotope. Short term estrogen and A.T. 10 treatments do not modify the excretion pattern. There is a significant amount of Sr^{90} bound to the red cells, perhaps owing to a certain degree of surface adsorption. The serum Sr^{90} is coprecipitated with the proteins, but there is a non-dialysable fraction, bound to the gamma globulin and also to the beta lipoprotein. Pregnancy does not change the rate nor the fixation pattern of circulating Sr^{90}. The distribution pattern of Sr^{90} in soft tissues is similar to that of calcium; there is a skin fixation of the isotope, around the pilo-sebaceous follicle and in some fibrillar structures. Pregnancy does not change the distribution pattern of Sr^{90} in soft tissues. The Sr^{90} transfer to the fetus is proportional to the size of the fetus. The transferred isotope derives from a depletion of the maternal bone storage in early pregnancy; during the second half of the gestation, a diminution of the urinary excretion adds to the bone depletion mechanism. The rate of transfer per gram fetus shows a maximum toward the third quarter of gestation and then diminishes sharply until the term. The Sr^{90}/Ca rate is identical in maternal as well as in fetal tissues. The Sr^{90} concentration in fetal tissues and fluids is similar to that of maternal tissues and fluids, with the exception of the amniotic fluid, devoid of isotope in fetus and a low urinary level in the three day old suckling. Placental tissue does not store Sr^{90}; the concentration of isotope is parallel to the growth rate of the organ, but the per gram level remains unchanged. The transfer rate of Sr^{90} does not exceed the needs of the growing embryo. The presence of a carrier for Sr^{90} in placenta has not been established. (auth)

30375 STUDIES OF THE CLINICAL APPLICATION OF COLLOIDAL RADIOYTTRIUM. T. Miyakawa, Y. Yoshizawa, and A. Nagatsuka (Tokyo Univ.). p.93-101 of "Radioaktive Isotope in Klinik und Forschung. Band IV." Munich-Berlin, Urban & Schwarzenburg, 1960. (In English)

Colloidal radioyttrium milked from strontium-90 was intracavitarily, intratumorally, or intravenously administered to patients with malignant neoplasms. No conclusions can be drawn as yet from the series of patients treated in this study. However, it was shown that radioyttrium may be used for radiocolloid therapy. The physicochemical properties of colloidal radioyttrium were demonstrated by means of dialysis and electron microscopy. In order to observe the distribution of the radioyttrium, scintigrams of the bremsstrahlung were performed. (auth)

30376 STUDIES ON THE TISSUE DISTRIBUTION OF COLLOIDS OF YTTRIUM AND LANTHANUM IN EXPERIMENTAL ANIMALS. B. J. Miles and A. R. Thomson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.102-19 of "Radioaktive Isotope in Klinik und Forschung. Band IV." Munich-Berlin, Urban & Schwarzenberg, 1960. (In English)

The preparation and properties of two new colloids, "yttrium-dextran" and yttrium-resin, are described. The distributions of these colloids of yttrium were found to be similar after intraperitoneal injection into mice bearing Ehrlich ascites tumors. Greater translocations of yttrium silicate and "yttrium-dextran" colloids took place in the presence of ascitic fluid than in its absence. The tissue distributions were also investigated as a function of time; greater deposition in most tissues occurred at 3 days than at 1 day, but this effect was not as marked at 6 days. More efficient localization of the injected activity in the peritoneum occurred with "La-dextran" colloid than with "Y-dextran" colloid, while more translocation occurred with higher molecular weight protectives. The results are discussed in relation to the existing literature on colloidal gold and other yttrium colloids. The use of the resin colloid for bladder irradiation and that of holmium-166 as an alternative to yttrium-90 is suggested. (auth)

30377 RADIOTHERAPY USING IRIDIUM-192 IMPLANTS. Werner Schlungbaum (Universität, Berlin). p.120-5 of "Radioaktive Isotope in Klinik und Forschung. Band IV." Munich-Berlin, Urban & Schwarzenberg, 1960. (In German)

Iridium-192 is well suited for implantation therapy. Its relatively long half-life gives biological, technical, and practical advantages with respect to the application of short-lived radioisotopes. Some examples explain the methodics. For clinical evaluation the number of patients is too small and the observation time is too short. (tr-auth)

30378 THE USE OF SHORT LIVED ISOTOPES IN THE PERFUSION THERAPY OF ISOLATED ORGANS. G. L. Brownell, W. H. Ellett, R. G. Ojemann, and W. H. Sweet (Massachusetts General Hospital, Boston). p.126-41 of "Radioaktive Isotope in Klinik und Forschung. Band IV." Munich-Berlin, Urban & Schwarzenberg, 1960. (In English)

The combination of short lived isotopes with perfusion techniques appears to offer promise in radiation therapy. Radiation of brain tumors by this technique is particularly promising because of the high tumor—normal brain ratio exhibited by many radioisotopes. Three short lived isotopes having properties suitable for such therapy are considered, Sc^{49}, Zn^{69}, and Dy^{165}. These three isotopes were prepared in the Massachusetts Institute of Technology reactor by neutron irradiation of calcium, zinc, and dysprosium. Physical studies were carried out on the beta and gamma radiation using beta ray absorption techniques, half life determination, and gamma ray spectroscopy. Biological studies were performed with mice and cats comparing the ionic and versenate form of scandium and dysprosium and the versenate form of zinc. All three substances showed excellent tumor-normal brain ratios in the versene form, dysprosium showing a slightly poorer ratio in ionic form and scandium-49 showing a poor ratio in ionic form. All three compounds exhibited decreased toxicity in versene form. Organ distributions are recorded in both mice and cats and concentrations in different portions of the brain and eye studied in detail. Calculations are presented on estimates of radiation dosage to patients undergoing cerebral perfusion for brain tumor therapy. The required concentrations to produce a tumor dose of 6000 rad are estimated and the dose to other organs has been calculated. (auth)

30379 IN VIVO MEASUREMENTS OF RADIOIRON IN THE STUDY OF SOME HAEMOLYTIC ANAEMIAS. A. M. Baptista, M. A. Perez Fernandez, R. Valadas Preto, and F. Branco (Instituto Portugues de Oncologia, Lisbon). p.142-59 of "Radioaktive Isotope in Klinik und Forschung.

Band IV." Munich-Berlin, Urban & Schwarzenberg, 1960. (In English)

It was shown by "in vivo" measurements over the sacrum, as representative of the erythropoietic system, and from the plasma clearance rate that it should be possible to study deviations of the normal iron metabolism with Fe^{59} in certain cases. In 13 cases of haemolytic anemia, we found that in half of the patients utilization of Fe^{59} by the erythrocytes was not diminished. In the 7 cases studied before and after splenectomy, four had high utilization, sometimes faster than normal, before splenectomy. In all cases normal or almost normal utilization was observed after splenectomy. In all the cases the plasma clearance rate was very much increased. Once more, correlation between the plasma clearance rate and the utilization was not found, although the increased erythrocyte destruction in haemolytic diseases could apparently influence the measured value of radioiron utilization. It seems necessary to consider these findings as well as the possibility of an inhibition of bone marrow by the spleen, as suggested by some authors. It was shown by body surface measurements of radioactivity, after radioiron administration, that it is possible to demonstrate the erythrocyte destruction of the spleen. This fact must be particularly emphasized for indication of splenectomy, especially in cases of haemolytic anemias without an absolute indication for this intervention (for instance, in Cooley's disease). In a case of sickle cell anemia where haematoclasia in the liver was disclosed, it was not possible to detect any significant increase of radioactivity over the spleen region corresponding to the probable existence of an "auto-splenectomy". (auth)

30380 IN VIVO MEASUREMENT OF THE ERYTHROCYTE LIFETIME USING THE Cr^{51} METHOD IN SICKNESS AND IN HEALTH. F. Wolf and S. Witte (Universität, Erlangen, Ger.). p.169-83 of "Radioaktive Isotope in Klinik und Forschung. Band IV." Munich-Berlin, Urban & Schwarzenberg, 1960. (In German)

The method used for Cr^{51} measurement of erythrocyte lifetime is described. Then the results obtained on the lifetime in patients with various illnesses are diagrammed. The damage to erythropoiesis and possible defects of the erythrocytes after cytostatic treatment was investigated. The effect of variable elution on the lifetime was then studied. The possible use of the urine activity for the quantitative comprehension of elution is reported. The spleen activity was also investigated. (J.S.R.)

30381 CLINICAL AND EXPERIMENTAL STUDIES WITH H^3-FOLIC ACID IN MEGALOBLASTIC ANAEMIAS. E. H. Belcher, B. Anderson, I. Chanarin, and D. L. Mollin (Postgraduate Medical School, London). p.184-93 of "Radioaktive Isotope in Klinik und Forschung. Band IV." Munich-Berlin, Urban & Schwarzenberg, 1960. (In English)

The value of H^3-folic acid for studying the absorption of folic acid was evaluated by comparing the fecal and urinary excretion of radioactivity after oral doses of 200 or 40 μg/kg body weight H^3-folic acid in a group of control subjects and in a group of patients with idiopathic steatorrhoea in whom there was evidence suggesting intestinal malabsorption of folic acid. Although there was some overlap between the results in the two groups, in general H^3 excretion is greater in the feces and less in the urine in patients with idiopathic steatorrhoea than in control subjects. H^3-folic acid therefore appears suitable for studying the absorption of the vitamin. (auth)

30382 SIMULTANEOUS DETERMINATIONS OF TOTAL BODY WATER, EXTRACELLULAR FLUID VOLUME, EXCHANGEABLE SODIUM AND TOTAL EXCHANGEABLE POTASSIUM IN MAN; A SIMPLIFIED TECHNIQUE AND SOME CLINICAL RESULTS. E. H. Belcher, T. R. Fraser, G. F. Joplin, J. D. H. Slater, and R. G. S. Taylor (Postgraduate Medical School, London). p.194-202 of "Radioaktive Isotope in Klinik und Forschung. Band IV." Munich-Berlin, Urban & Schwarzenberg, 1960. (In English)

A simple and accurate method for the simultaneous determination of total exchangeable sodium, total exchangeable potassium, extracellular fluid volume, and total body water using isotope dilution analysis with Na^{24}, K^{42}, Br^{82}, and H^3 is described. The method involves assays of mixtures of these four isotopes in plasma and urine samples. Br^{82} is readily separated from biological fluids by anion exchange resins, H^3 is measured after the radioactivity of the other isotopes has decayed sufficiently. The Na^{24} and K^{42} activities are differentiated by subtraction of activities measured with a well scintillation counter and a Geiger-Mueller tube. Examples of the results obtained are given. (J.S.R.)

30383 THE SIGNIFICANCE OF TOTAL EXCHANGEABLE SODIUM AND POTASSIUM ESTIMATIONS. J. P. Nicholson and J. F. Zilva (Westminister Hospital Medical School, London). p.203-14 of "Radioaktive Isotope in Klinik und Forschung. Band IV." Munich-Berlin, Urban & Schwarzenberg, 1960. (In English)

An attempt was made to derive a variable which would express the proportion of adipose to lean tissue in any given subject and to relate the observed electrolyte content to it. An obesity index, obtained by plotting the log of the weight of normal persons against their height, was obtained. A good negative correlation was found between the obesity index and the specific gravity. The obesity index was shown to be a parameter of the Na and K determinations. Curves are given showing the relation between K and Na per unit weight and the obesity index. Borderline abnormalities can be detected with the obesity index. (J.S.R.)

30384 STUDY OF THE DEPLETION STATE OF POTASSIUM USING K^{42}. C. Nagant de Deuxchaisnes, E. Loizeau, R. A. Collet, and R. Busset (Clinique Universitaire de Therapeutique, Geneva and Hôspital Cantonal, Geneva). p.215-26 of "Radioaktive Isotope in Klinik und Forschung. Band IV." Munich-Berlin, Urban & Schwarzenberg, 1960. (In French)

Different states of kaliopenia (decrease of K_e) were studied. In denutrition, K_e is always decreased, but K_e/kg can be either normal or even slightly increased or decreased; this decrease of the K_e/kg can result either from a pseudo-depletion or a real depletion. These differences permit three types of denutrition to be distinguished. In cardiac decompensation or hapatic cirrhosis, K_e and K_e/kg are always decreased. The analysis of the results, in particular in subjects without clinically detected liquid retention (stage I) and with an index of normal corpulence, has permitted the conclusion that there exists in these illnesses a real depletion of potassium. As the result of overcharge tests made, this state of depletion can not be corrected by an exogenic K deposition. A general classification of the troubles of potassium metabolism is suggested. (tr-auth)

30385 ABSORPTION AND DISTRIBUTION OF RUBIDIUM-86 IN HYPERKALAEMIA AND ACIDOSIS. F. K. Bauer, N. Telfer, and M. A. Jenkins (Univ. of Southern California, Los Angeles and Los Angeles County Hospital, Los Angeles). p.227-38 of "Radioaktive Isotope in Klinik und Forschung. Band IV." Munich-Berlin, Urban & Schwarzenberg, 1960. (In English)

Rubidium-86 is completely absorbed from the gastroin-

testinal tract in patients with hyperkalaemia. Plasma Rb^{86} concentration in hyperkalaemics remains higher than those of the control subjects. Red cell Rb^{86} concentrations are slightly lower than those of the control subjects in the first two days after administration of a tracer dose of Rb^{86} and are of the same magnitude as the controls on the third day. A ratio of 22:1 of red cell/plasma Rb^{86} is reached on or about the third day in controls and later in hyperkalaemic subjects. Intravenous infusions of $NaHCO_3$, in an effort to correct the acidosis, resulted in a shift of extracellular Rb^{86} into intracellular spaces. Glucose with insulin was less effective. (auth)

30386 METHOD OF USING AND MANUFACTURING PLASTIC EQUIVALENT TO ORGANIC MATERIALS. Francis R. Shonka, John E. Rose, and Gioacchine Failla (to U. S. Atomic Energy Commission). U. S. Patent 3,005,794. Oct. 24, 1961.

Compositions of matter that have the radiation response of animal muscle tissue, bone, or air were prepared. These compositions are composed of specific proportions of three or more of the following constituents: polyethylene plastic, polyamide plastic, oil furnace black, silica, and calcium fluoride. (AEC)

Biochemistry, Nutrition, and Toxicology

30387 (A/AC.82/G/L.621) PEREKHOV Sr^{90} OT MATERI K POTOMSTVU I IZMENENIYA NERVNOI I SERDECHNO-SOSUDISTOI SISTEMY U POSLEDNIKH. (The Transfer of Strontium-90 from Mother to Offspring and the Change in the Nervous and Cardiovascular Systems of the Latter). M. A. Levchenko (U.S.S.R. Soviet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). Aug. 28, 1961. 25p.

Tests were made of nervous and cardiovascular system development in progenies of 240 female and 110 male rats suffering from radiation sickness induced by intraperitoneal doses of Sr^{90}. It is shown that the parents transmit radioactive isotopes into their progenies through the placenta and milk. In the first generation, uptake was $0.91 \pm 0.21\%$; in the second, $0.16 \pm 0.04\%$; and in the third, $0.06 \pm 0.03\%$ of the mother's dose. Changes in the nervous system are expressed in more rapid exhaustion of cortex cells and in heart automatism, which is related to disturbance of the heart action and metabolic changes. The symptoms disappear in mature animals. Symptoms in progenies born 40 days after inclusion of Sr^{90} into the mother are the results of transmittal to the progenies rather than action on the mother. (R.V.J.)

30388 (TID-12766) PASSAGE OF WATER AND OTHER SUBSTANCES ACROSS BIOLOGICAL BARRIERS IN VIVO. METABOLIC ACTIVITIES OF ORGAN SYSTEMS IN VIVO. Supplementary Progress Report, September 15, 1958–June 15, 1961. Theodore Enns ([Johns Hopkins Univ., Baltimore. School of Medicine.]). Contract AT(30-1)-1394. 11p.

Investigations on the mechanisms involved in the passage of water and certain other substances across various biological barriers in vivo and in vitro, and the metabolic activities of the kidney in vivo were carried out on anesthetized mongrel dogs. In the studies on the pulmonary system, it was found that equilibration in the carbon dioxide system is not established in the time of transity of blood through the pulmonary capillaries under conditions of carbonic anhydrase inhibition. Water was found to be distributed in a volume significantly greater than the volume available to substances known to remain in the blood stream, such as labeled proteins. In the renal transport and metabolic studies, the recoveries in renal vein blood of glucose injected into the renal artery were found to be essentially complete. Other results including sources of renal carbon dioxide production are also discussed. (P.C.H.)

30389 (UCRL-9755) SELECTIVE BETA IRRADIATION OF THE LYMPHATIC SYSTEM USING INTERNALLY ADMINISTERED Y^{90} DTPA: KINETICS, DOSIMETRY, AND BIOLOGICAL EVALUATION (thesis). Harry S. Winchell (California. Univ., Berkeley. Lawrence Radiation Lab.). June 14, 1961. Contract W-7405-eng-48. 162p.

In order to provide for the relatively selective irradiation of the tissue responsible for the homograft rejection response while minimizing the exposure of other tissues, a technique using internally administered Y^{90} chelated with DTPA (diethylene-triamine-pentaacetic acid) was developed. By use of continuous intravenous recycling of the urine containing the excreted Y^{90}-DTPA a method was developed in which dosimetry is controllable and the excretion of the radioactivity from the body following the cessation of urine recycling is rapid, thereby permitting bone marrow transplantation within 24 hours following the procedure. The clinical, hematologic, and pathologic postirradiation responses of animals receiving Y^{90}-DTPA by this method was observed for each group of animals studied. Dogs given sublethal doses of radiation generally had a benign clinical course, the only remarkable finding being a selective lymphopenia without depression of granulocytes, platelets, or reticulocytes. Lethally irradiated dogs showed depression of all formed blood elements but severe depression of lymphocytes was most prominent. Autologous bone marrow is capable of repopulating hematopoietic and lymphopoietic tissues with associated survival of lethally irradiated dogs. Successful homologous bone marrow transplantation apparently was achieved between unrelated beagle dogs. Thus, a new radiation procedure was developed which offers greater selectivity in suppressing the activity of lymphatic structures, and presumably the homograft rejection response. The results suggest the usefulness of this procedure in the treatment of malignancies of lymphatic structures and in the preparation of large mammals for transplantation of homologous tissues. (auth)

30390 (AEC-tr-4808) THE PHYSIOLOGICAL ROLE OF BORON. 1. ELIMINATION OF BORON DEFICIENCY BY USING NUCLEIC ACID. M. Ya. Shkol'nik and E. A. Solov'eva. Translated by Lydia Venters (Argonne National Lab., Ill.) from Botan. Zhur., 46: No. 2, 161(1961). 17p.

The possibility of eliminating a marked boron deficiency by introducing free ribonucleic acid into the nutrient solvent, is shown. The data obtained indicate the great role of boron in nuclein metabolism. The inadequacy of the hypothesis of Gauch and Dugger was shown, and an hypothesis is promoted according to disturbances in nuclein metabolism that cause the dying away of the growing points of boron-deficient plants. The data allow an explanation of the cause of such a great necessity of the meristematic tissues for boron, its importance in the division of cells, differentiation of tissues, and construction of cellular membranes. (auth)

30391 (AEC-tr-4818) UPTAKE AND DISTRIBUTION OF BORON, MANGANESE AND MOLYBDENUM IN PLANTS. T. A. Paribok. Translated by Lydia Venters (Argonne National Lab., Ill.) from Eksptl'. Botan., 4: No. 12, 268-? (1958). 25p.

The content and distribution of boron, manganese, and molybdenum in plants during their growth and development were investigated using flax and wheat as examples. The plants obtained these trace elements in the form of ceramic or vitreous fertilizers (fritt). The plants were raised in podzolic soil, in which the fritts of different composition were introduced. The elements were determined in the plants by colorimetric methods. The accumulation of the B, Mn, and Mo in all over-ground organs of the wheat and flax increased during the period of plant growth and development. The absorption of the elements in the process of ontogenesis occurred at different rates. The accumulation of Mn in wheat and B in flax was proportional to the accumulation of the dry substance in plants. The character of the accumulation of Mo in wheat did not correspond to the changes in the dry weight. The content of the elements in the stalks increased from the bottom to the top. In flax the largest amount of B was accumulated in seedcases and seeds and Mn in the leaves. In wheat, B was mainly concentrated in the leaves, but Mn in ears and grain. The differences in distribution of Mo were less pronounced. (M.C.G.)

30392 P^{32} UPTAKE IN DNA NUCLEOTIDES AFTER PARTIAL HEPATECTOMY AND AFTER UNILATERAL NEPHRECTOMY. David P. Simpson (Scripps Clinic and Research Foundation, La Jolla, Calif.). Am. J. Physiol., 201: 523-5(Sept. 1961).

Deoxyribonucleic acid (DNA) synthesis as reflected in the specific activity of DNA nucleotides 12 hr after intraperitoneal injection of P^{32} was compared after partial hepatectomy and after unilateral nephrectomy. Thirty-six hours after partial hepatectomy, a maximum uptake 11-fold greater than in controls was found. The maximum after unilateral nephrectomy occurred 48 hr after operation and was twofold greater than in controls. Subsequent to these maxima, P^{32} uptake declined after both operations to a minimum eight days postoperatively which was followed by a second rise on the 9th day. These data support the concept that similar basic mechanisms regulate growth and cell division after the two types of operation. In another experiment, P^{32} uptake in kidney DNA nucleotides showed no increase after partial hepatectomy; this lends weight to the hypothesis that the mitosis-stimulating substances which appear in the serum after partial hepatectomy and after unilateral nephrectomy are organ specific. (auth)

30393 RADIOACTIVE OXYGEN 15 IN STUDY OF KINETICS OF OXYGEN OF RESPIRATION. Michel Ter-Pogassian, John S. Spratt, Jr., Sanford Rudman, and Andrew Spencer (Washington Univ., St. Louis). Am. J. Physiol., 201: 582-6(Sept. 1961).

A system for the production and purification of radioactive oxygen-15 was developed. Oxygen-15 decays with a half-life of 2.25 min by the emission of positrons. The isotope is prepared by irradiation of nitrogen by means of cyclotron-accelerated deuterons. Air tagged with O^{15} was applied to the study in dogs of the kinetics of the transfer of oxygen from pulmonary gases to blood, the rate of incorporation of oxygen into water during metabolism, and the rate of exchange of plasma water with tissue water. (auth)

30394 EFFECTS OF GROWTH HORMONE AND CORTICOSTEROIDS ON S^{35} FIXATION IN CARTILAGE. Charles W. Denko and Delbert M. Bergenstal (Argonne Cancer Research Hospital, Chicago and Univ. of Chicago). Endocrinology, 69: 769-77(Oct. 1961).

The duration of treatment necessary to produce a significant stimulation in S^{35} uptake was 48 hours. Results after four days of treatment were nearly maximal. The effective biological life of circulating growth hormone as measured by the incorporation of S^{35} in cartilage is from 24 to 48 hours. The disappearance curve reflecting the metabolic activity of S^{35} containing compounds in cartilage closely approximates the previously reported half-life of radiochondroitin sulfate, that is, seventeen days. The use of human serum as a vehicle for growth hormone produces no modification of its action, while the use of ten % gelatin as a vehicle results in a slight decrease in S^{35} binding. The subcutaneous route of administration of the hormone is as effective as the intraperitoneal route. Hydrocortisone inhibits S^{35} fixation to about one-half of the level noted in control animals. Hydrocortisone also inhibits the stimulatory action of growth hormone, and conversely growth hormone antagonizes the action of hydrocortisone. Cortisone and 9-fluohydrocortisone behave similarly to hydrocortisone in reducing S^{35} incorporation into cartilage and in reducing the increase in body weight. Hydrocortisone hemi-succinate and tetrahydrocortisone produced no notable effect on these processes. (auth)

30395 EFFECTS OF SOY-FLOUR DIET AND OTHER AGENTS ON EXCRETION OF I^{131} AFTER USE OF LABELED THYROXINE IN THE RAT. James R. McPherson and A. Albert (Mayo Clinic and Mayo Foundation, Rochester, Minn.). Endocrinology, 69: 856-62(Oct. 1961).

The fecal and urinary excretion of I^{131} after injection of radioactive thyroxine was measured in rats fed diets of soy flour, starch-casein, standard laboratory chow, and the Remington mixture. Rats fed the soy-flour, starch-casein, and Remington diets excreted less I^{131} in the feces than did control rats. No difference was present in the biliary excretion of I^{131} or in the transformation of I^{131}-thyroxine by the intestinal contents. The weight of stools of the rats consuming the test diets was one-half that of the control group. The thyroidal uptake of I^{131} and the serum protein-bound iodine (PBI) were low in the rats fed soy-flour diets. The thyroid showed a small increase in weight, but the gland exhibited less cellular activity as compared with the control group. It was concluded that the fecal excretion of I^{131} after administration of labeled thyroxine is not easily altered. An increase in the bulk of the stools or an increase in biliary excretion of I^{131} allows an abnormally increased loss of I^{131} in the feces. A decrease in weight and bulk of the stools is accompanied by a decreased loss of I^{131}. The small goiter produced in rats fed soy flour did not appear to be on the basis of excessive loss of thyroxine in feces. (auth)

30396 ACCUMULATION OF RADIOSTRONTIUM BY BACTERIAL CELLS. V. M. Zhogova. Gigiena i Sanit., No. 4: 5-9(1961).

Similar to other aquatic organisms, bacteria are capable of accumulating considerable amounts of strontium-90 from the water polluted with the isotope. In an hour the microbic cells become 10 to 100 times more radioactive than the surrounding medium, and, consequently, they are an important link in the food chains by means of which radioactive strontium may reach the body of men and animals from the polluted water basins. It was noted that the smaller concentration of bacterial suspension and the lower the specific activity of medium, the higher the coefficient of radiostrontium accumulation in bacterial cells. However, irrespective of the concentration of microbes, the bacterial suspension extracts from the liquid medium an average of 10% of strontium-90. Therefore bacterial and activated sludge may not be successfully used for the removal of this isotope from the radioactive wastes and effluents. The

process of physico-chemical adsorption is most probably the basis of the strontium accumulation in bacterial cells. (Public Health Eng. Abstr., 41: No. 8, 1961)

30397 METABOLISM OF ZINC-65 IN THE RAT. CONSIDERATION OF PERMISSIBLE EXPOSURE LIMITS. John E. Ballou and Roy C. Thompson (General Electric Co., Richland, Wash.). Health Phys., 6: 6-18(Aug. 1961). (HW-SA-2020)

Data are presented on the absorption of Zn^{65} under various conditions, on its distribution and retention following a single administration, and on its buildup in tissues during chronic feeding. Highest concentrations of Zn^{65} were observed in hair, bone, and prostate, the three tissues which did not attain steady-state levels of Zn^{65} during extended periods of Zn^{65} feeding. Accumulation in the total-body appears to be the critical consideration, however, due to the greater absorption of the decay energy in the larger organism and the lower permissible dose rate recommended for total body irradiation. Special consideration may need be given to the very young, in view of the ready transfer of Zn^{65} across the placenta and the enhanced intestinal absorption during the first few weeks of life. (auth)

30398 THE RELATIVE DISTRIBUTIONS OF RADIOACTIVE YTTRIUM AND STRONTIUM AND THE SECONDARY DEPOSITION OF Y^{90} BUILT UP FROM Sr^{90}. Intern. J. Radiation Biol., 3: 475-92(Sept. 1961). (In English)

Weanling rabbits were injected intravenously with one of three solutions: Sr^{90} (free from Y^{90}), $Sr^{90} + Y^{90}$ in equilibrium, and Y^{91}, to compare the relative distributions of strontium and yttrium and to establish whether Y^{90} formed by Sr^{90} decay escaped from sites of its original deposition. The animals were sacrificed at different times up to 30 days after injection, and samples of bone and soft tissues were assayed by means of a beta scintillation counter. The measurements on bone showed the concentrations (in $\mu c/g$ of bone) of strontium and yttrium to be approximately equal. Soft tissues showed a much higher concentration of yttrium than of strontium, but those having highest concentrations of yttrium also had relatively high concentrations of strontium, namely cartilage, pituitary, and kidney. Measurements of the Y^{90}, built up when Sr^{90} (free from Y^{90}) was injected, showed that Y^{90} was built up in the liver in excess of the amount predicted from the deposition of Sr^{90}. (auth)

30399 A RADIOMETRIC DETERMINATION OF FATTY ACIDS ON PAPER CHROMATOGRAMS. R. Otto (Institut für angewandte Radioaktivität, Leipzig). Isotopentechnik, 1: 184(May 1961). (In German)

For the quantitative analysis of paper chromatographically separated mixtures of the higher fatty acids, the fatty acid salts were formed on the paper with $Co^{60}(CH_3COO)_2$ solutions. In this manner it is possible with the help of comparison chromatograms, developed and radiometrically evaluated in the same manner as the analysis chromatograms, to determine accurately to within ±2.5% the myristic, lauric, palmitic, and stearic acids contained in the mixture. (tr-auth)

30400 THE PATH OF INTRAVENOUSLY INTRODUCED METALLIC COLLOID IN THE RABBIT. László Kertész (Inst. of Nuclear Research, Hungarian Academy of Sciences, Debrecen). Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrecen), Közlemények, 3: 17-36(1961). (In Hungarian)

The factors, such as diffusion and filtration phenomena, involved in the establishment of the equilibrium between the organism and the materials introduced into blood circulation were investigated by determining the retention of the material in the various organs as a function of time. A Bi_2S_3 colloid tagged with radioactive Bi in a protective gelatin medium was injected into the ear or the jugular vein of the test animals. On the basis of the decay curve of activity of the material the following processes could be distinguished: a) an initial mixing and rapid retention completed within about 10 circulation periods of 25 sec; b) an intermediate equilibration process resulting in a dynamic equilibrium between the organs and the blood, completed within 18 hours; c) an elimination process which follows a simple exponential scheme. The effect of the type of the colloid on these processes could not be ascertained. The specific ability of the liver, the spleen, and the bone marrow to store Bi was calculated on the basis of the μg Bi/g wet organ ratio. (116 references) (TTT)

30401 PROBLEMS OF THE RADIOACTIVE IODINE METABOLISM WITH SPECIAL RESPECT TO THE DYNAMIC EQUILIBRIUM OF THE THYROID FUNCTION. László Kertész (Inst. of Nuclear Research, Hungarian Academy of Sciences, Debrecen). Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrecen), Közlemények, 3: 37-42(1961). (In Hungarian)

It has been noted during routine I metabolism studies that the I uptake of test animals subjected to surgical intervention is considerably reduced. This problem was studied in vivo in rats, introducing I^{131} orally into the stomach in amounts of 5μ curie/0.5 ml, washing it down with water and air, and using median laparotomy as the operational trauma for affecting the thyroid function. A shift of the thyroid's I uptake curve as a function of the time of introduction of the I has been noted: laparotomy performed more than 24 hours after the introduction of I^{131} did not have any effect on the adsorption process. The results indicated that stress-generating factors may also have an inverse effect. Although the animals subjected to trauma show a deficiency in the amount of I stored in the thyroid, no difference could be found in the qualitative distribution of I comparing it with that of the control animals thus indicating that non-thyroidal factors are probably responsible for the observed effect. (TTT)

30402 EFFECT OF ADRENALECTOMY AND CORTICOSTEROIDS ON DISTRIBUTION OF RADIOACTIVITY IN PROTEIN OF CELL FRACTIONS FROM MYOCARDIAL SLICES. Edward I. Weinshelbaum and Ira G. Wool (Univ. of Chicago). Nature, 191: 1401-2(Sept. 30, 1961).

Heart slices were incubated with C^{14}-phenylalanine and the distribution of radioactivity in the protein of cell fractions determined in an attempt to identify the locus at which corticosteroids influence protein biosynthesis. However, the results are considered preliminary. After adrenalectomy the specific radioactivity of the protein in each of the fractions of heart muscle (debris, mitochondria, microsomes, soluble fraction) is increased. The magnitude of the effect of adrenalectomy on amino acid incorporation into heart microsomes suggests the possibility that they are the intracellular site at which adrenalectomy acts to enhance protein biosynthesis. Cortisone depressed amino acid incorporation into each of the cellular fractions of myocardium. In contrast with the changes after adrenalectomy, the decrease after cortisone was equal in each fraction (20 to 30%), and not nearly so great. The distribution of radioactivity in the protein of the several fractions, then, offers no clue to the mode of intracellular action of cortisone in depressing protein biosynthesis. (P.C.H.)

30403 ROOT ABSORPTION OF FISSION PRODUCTS BY BROMUS RUBENS L. FROM THE AEC NEVADA TEST SITE SOIL CONTAMINATED BY AN UNDERGROUND NU-

CLEAR EXPLOSION. H. L. Mills and L. M. Shields (New Mexico Highlands Univ., Las Vegas). Radiation Botany, 1: No. 1, 84-91(Sept. 1961).

By the Neubauer type of culture, Bromus rubens L. plants were grown to maturity in soil from a crater formed by an underground nuclear detonation (Blanca event) at the Nevada Test Site. Plants and soil were analyzed to determine the extent of root absorption of fission products. Of total plant radioactivity, ruthenium-rhodium-106 comprised 42.3%; strontium-yttrium-90, 46.6%, lanthanide rare earths (cerium-praseodymium-144), 10.2%, and zirconium-niobium-95, 0.9%. Of the total soil radioactivity, the combined leaf-stem-inflorescence-grain portions of the total crop were found to contain 0.34% of the strontium-yttrium; 0.065% of the soil ruthenium-rhodium-106; 0.0625% of the zirconium-niobium-95; and 0.01125% of the soil lanthanide rare earths. Activity ratios of plant/soil showed absorption coefficients of 36 for strontium-yttrium; 3.3 for ruthenium-rhodium-106; 0.63 for lanthanide rare earths; and 0.3 for zirconium-niobium-95. Absorption coefficients for leaf-stem fractions were 29.1 for strontium-yttrium; 6.5 for ruthenium-rhodium; 1.75 for lanthanide rare earths; and 0.61 for zirconium-niobium. Absorption coefficients for grain-inflorescence fractions were 13.04 for strontium-yttrium; 2.1 for ruthenium-rhodium; 0.2 for zirconium-niobium; and 0.175 for the lanthanide rare earths. On a comparative dry weight basis, the leaves-stems portion accumulated a higher percentage of soil radioactive contaminants than the inflorescence-grain portion. While comprising only 29% of total plant dry weight, the leaves-stems tissues accumulated 80.35% of the lanthanide rare earths, 55.8% of the ruthenium-rhodium-106, 55.1% of the zirconium-niobium-95, and 47.6% of the strontium-yttrium-90. The grain-inflorescence tissues, while comprising 71% of the total plant dry weight, accumulated 52.4% of the strontium-yttrium-90, 44.9% of the zirconium-niobium-95, 44.2% of the ruthenium-rhodium-106, and 19.65% of the lanthanide rare earths. Leaf-stem accumulation shows ratios of 2.77 for lanthanide rare earths, 1.97 for ruthenium-rhodium-106, 1.94 for zirconium-niobium-95, and 1.63 for strontium-yttrium-90. Grain-inflorescence accumulation shows ratios of 0.277 for the lanthanide rare earths, 0.635 for ruthenium-rhodium-106, 0.649 for zirconium-niobium-95, and 0.728 for strontium-yttrium-90. (auth)

30404 THE CELL NUCLEUS. Proceedings of an Informal Meeting Held at the Department of Radiotherapeutics, University of Cambridge, 31 August-1 September 1959, by The Faraday Society. J. S. Mitchell, ed. New York, Academic Press Inc. and London, Butterworths, 1960. 278p.

Thirty-eight papers are included on molecular architecture and the biochemistry of the cell nucleus. Separate abstracts have been prepared for six papers. (C.H.)

30405 X-IRRADIATION OF THE NUCLEOLUS AND ITS EFFECT ON NUCLEIC ACID SYNTHESIS. J. Seed (Univ. of Cambridge, Eng.). p.49-52 of "The Cell Nucleus." New York, Academic Press, Inc. and London, Butterworths, 1960.

An apparatus was constructed for irradiating small areas of a living cell with an x-ray beam of 2.5 μ effective cross section. Quantitative ultraviolet photomicrography was used in conjunction with localized x irradiation to compare the effects of nucleolus and nuclear fluid irradiation on nucleic acid synthesis. Muscle heart fibroblasts grown in tissue culture were used as test material. (C.H.)

30406 THE EXCRETION OF DEOXYCYTIDINE IN THE URINE AFTER IRRADIATION. Some Remarks on the Specific Metabolic Position of Deoxycytidine. J. Pařízek (Czechoslovak Academy of Sciences, Prague). p.82-8 of "The Cell Nucleus." New York, Academic Press, Inc. and London, Butterworths, 1960.

Results are presented from a study of the excretion of desoxycytidine in the urine and the role of desoxycytidine among other desoxyribonucleosides in the synthesis of desoxyribonucleic acid. Results indicate that desoxycytidine is a normal constituent of urine and is excreted in relatively large quantities in normal animals. Experiments in rats showed that irradiation and radiomimetic substances increase the excretion of desoxycytidine. The amount excreted during 24 hr after irradiation correlated well with radiation dose even at relatively low doses. Possible reaction mechanisms are discussed. (C.H.)

30407 A CYTOCHEMICAL AND AUTORADIOGRAPHIC STUDY OF DEOXYRIBONUCLEIC ACID SYNTHESIS IN INDIVIDUAL NUCLEI AND THE EFFECTS OF IRRADIATION ON SYNTHESIS. W. B. Looney (Univ. of Cambridge, Eng.). p.98-125 of "The Cell Nucleus." New York, Academic Press, Inc. and London, Butterworths, 1960.

The change in the number of hepatocytes in regenerating rat liver synthesizing desoxyribonucleic acid between the onset of synthesis at 15 hr after hepatectomy and the onset of mitosis at 24 hr after hepatectomy was determined autoradiographically following the utilization of tritiated thymidine. It was found that a linear increase in the number of hepatocytes synthesizing desoxyribonucleic acid of approximately 4%/hr occurred during the first 5 hr after the onset of synthesis at 15 hr. There was a decrease between 20 hr and the onset of mitosis at 24 hr after hepatectomy. Quantitative autoradiographic studies suggest that changing rates of desoxyribonucleic acid synthesis occur in a hepatocyte during the process of replication. It was possible to follow individual nuclei throughout the replication of the desoxyribonucleic acid by labelling the nuclei with tritiated thymidine and measuring the DNA content at varying times after the administration of tritiated thymidine. Results are consistent with the hypothesis that irradiation directly affects the biosynthesis of desoxyribonucleic acid. The quantitative autoradiographic studies suggest that the immediate reduction in desoxyribonucleic acid synthesis following irradiation is proportional to the rate of desoxyribonucleic acid synthesis at the time of irradiation. (C.H.)

30408 AUTORADIOGRAPHIC STUDIES OF RIBONUCLEIC ACID METABOLISM WITH TRITIUM-LABELLED CYTIDINE. P. S. Woods (Brookhaven National Lab., Upton, N. Y.). p.127-37 of "The Cell Nucleus." New York, Academic Press, Inc. and London, Butterworths, 1960. (BNL-5321)

Results are reported from a series of studies on the function of ribonucleic acid (RNA) in cells. Seedlings of Vicia faba were grown on nutrient solutions containing tritiated cytidine, a precursor of both ribonucleic acid and desoxyribonucleic acid (DNA). Differential extraction techniques using perchloric acid were employed to distinguish a label due to RNA from that due to DNA. By comparing autoradiographs of adjacent unextracted and extracted sections of individual cells, it was possible to study incorporation into both nucleic acids separately and simultaneously in the same cell. Results agree with the hypothesis that RNA is the intermediate synthesized under the influence of the genes, that it carries genetic information to other sites of the cell where it presumably is involved in the synthesis of specific proteins. (C.H.)

30409 MORE ON THE MECHANISM OF RADIATION EFFECT ON THE PROCESS OF DEOXYRIBONUCLEIC ACID SYNTHESIS. L. G. Lajtha (Churchill Hospital, Oxford). p.144-6 of "The Cell Nucleus." New York, Academic Press, Inc. and London, Butterworths, 1960.

Results are reported from a series of studies on the effects of radiation on the synthesis of desoxyribonucleic acid in rat lymphocytes and mouse Ehrlich ascites cells both in vivo and in vitro. Tritiated thymidine, C^{14}-labeled formate, tritium, and P^{32} were used as tracers. Results are summarized and the effects of tracer specific activity are discussed. (C.H.)

30410 EFFECTS OF X-IRRADIATION ON DEOXYRIBONUCLEIC ACID SYNTHESIS IN CULTURED CELLS. J. Paul (Univ. of Glasgow). p.147-50 of "The Cell Nucleus." New York, Academic Press, Inc. and London, Butterworths, 1960.

Results of studies on the effect of irradiation with 1500 r on the incorporation of C^{14}-labeled formate into desoxyribonucleic acid (DNA) and ribonucleic acid (RNA) led to the conclusion that three separate phases are present in the irradiation syndrome of cultured cells. The first is a phase of temporary inhibition of DNA synthesis, followed by the synthesis of cell components at the same rate as in unirradiated cells, but without division of cells and the consequent formation of giant cells. In the third stage the cells increase in size and become static. There is no gross synthesis during this stage but the cells are still capable of incorporating thymidine into DNA. (C.H.)

Fallout and Ecology

30411 (ORNL-3119) STATUS REPORT NO. 1 ON CLINCH RIVER STUDY. R. J. Morton, ed. (Oak Ridge National Lab., Tenn.). Aug. 4, 1961. Contract W-7405-eng-26. 88p.

A study of the Clinch River below Oak Ridge National Laboratory was initiated in Feb. 1960 to obtain fundamental information on the physical, chemical, and biological dynamics of this fresh-water stream which receives large volumes of low-level radioactive wastes. The fate of radioactive materials discharged to the river, the mechanisms of dispersion of radionuclides released to the river, the direct and indirect hazards of current disposal practices in the river, and the over-all usefulness of this river for radioactive waste disposal purposes will be studied. Information obtained will have important implications for problems involving large-scale environmental contamination such as the over-all diluent capacity of fresh-water environments for the continuous input of large volumes of low-level radioactive wastes and the long-term indirect impact of radioactive contamination on such an environment. White Oak Creek, which drains the site of Oak Ridge National Laboratory, flows into the Clinch River, a tributary of the Tennessee River. The Clinch and Tennessee Rivers are described and available data on the physical, chemical, and biological conditions of the rivers are summarized. Data are included from preliminary studies on the properties of water and bottom sediments, studies on radionuclide interactions with minerals and river sediment, biological studies on plants and animals, and hydrologic studies. (C.H.)

Radiation Effects on Living Tissues

30412 (A/AC.82/G/L.593) AN INVESTIGATION OF GONAD DOSE EXPOSURE IN RADIOTHERAPY OF NON-MALIGNANT CONDITIONS. J. Jakoubková, M. Lokajicek, and V. Stasek (Karlova Universita, Prague). [1959]. 5p.

Examination of records for x-ray treatment of non-malignant conditions revealed that gonad doses attained high values only in cases of irradiation of the hip joint and lumbo-sacral spine. Gonad doses from irradiation of other parts of the body are low, but in view of further exposure from treatments and from radiodiagnosis, they are of significance as a cumulative factor. Similarly, the integral dose rises, and its biological significance as a leukemogenic factor cannot be ignored. (B.O.G.)

30413 (A/AC.82/G/L.602) SURVEY OF RADIOACTIVITY IN FOOD CONSUMED IN AUSTRIA. Report on First Sampling Period, June–December 1960. (International Atomic Energy Agency, Vienna). June 15, 1961. 52p.

Measurements were made of radioactivity of Austrian food from June to December 1960. Sources of contamination and nuclides to be considered and selection of samples are discussed. Cs^{137}, Sr^{90}, Ca, and K were determined in milk and cheese, cereals, potatoes, fruits, and vegetables. The average Sr^{90} content of normal Austrian diet was determined. (M.C.G.)

30414 (A/AC.82/G/L.617) VOZDEISTVIE IONIZIRUYUSHCHEI RADIATSII NA NUKLEINOVYI OBMEN POLOVYKH KLETOK SAMTSOVPROIZVODITELEI V SVYAZI S RAZVITIEM MUZHSKIKH I ZHENSKIKH OSOBEI V IKH POTOMSTVE. (Effect of Ionizing Radiation on the Nucleic Metabolism in Sex Cells of Breeding Males in Relation to the Development of Male and Female Characters in Their Progeny). V. N. Shreder (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). Aug. 28, 1961. 8p.

Radiation effects on the sex ratio in progenies of male rabbits and on the nucleic exchange in the sex cells were studied in 2500 to 3000 g rabbits exposed to whole-body doses of 50, 100, 200, 250, 400, 500, and 600 r and local doses to the testis of 25, 50, 75, and 100 r. The results showed a pronounced change in male sperm nucleic metabolism with considerable shift in progeny sex ratio toward male predominance. (R.V.J.)

30415 (A/AC.82/G/L.618) KOLICHESTVENNAYA KHARAKTERISTIKA CHUVSTVITEL'NOSTI TSENTRAL'NOI NERVNOI SISTEMY K IONIZIRUYUSHCHEMU IZLUCHENIYU. (Quantitative Study of the Sensitivity of the Central Nervous System to Ionizing Radiation). A. B. Tsypin and Yu. G. Grigor'ev (U.S.S.R. Soviet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). Aug. 28, 1961. 5p.

Early reactions of the nervous system revealed by the electroencephalographic method were employed as a sensitivity index. The data obtained characterize the relationship between the time of the appearance of the reaction and the dose rate. There was a general regularity in the reaction of the excitable systems in response to the radiation effect. (auth)

30416 (A/AC.82/G/L.619) O ROLI RADIATSIONNOGO POVREZHDENIYA VNUTRIKLETOCHNYKH POVERKHNOSTEI RAZDELA V BIOLOGICHESKOM DEISTVII IONIZIRUYUSHCHIKH IZLUCHENII. (The Role of Radiation Injury to Intracellular Membranes in the Biological Effects of Ionizing Radiation). A. G. Pasynskii (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). Aug. 28, 1961. 14p.

Measurements of SH-group albumins, of S^{35}-methionine binding, radiation destruction and binding of DNA help de-

termine molecular mutability in albumin irradiated at 400 to 500 r and in nucleoproteins at 20 to 40 r. It is shown that chemical binding in DNA monolayers disturbs the structure and increases the monolayer area while radiation injury of thin surface layers of RNA (peroxidazoascorbic acid, H_2O_2) leads to increased interactions. Injuries to separate molecules in the interface layer act as the source of further biochemical disturbance and radiation injury in life cells. (R.V.J.)

30417 (A/AC.82/G/L.628) REAKTSII MOZGOVOGO SLOYA NADPOCHECHNIKOV PRI VOZDEISTVII NA ORGANIZM MALYKH DOZ IONIZIRUYUSHCHEI RADIATSII V USLOVIYAKH VNUTRENNEGO OBLUCHENIYA. (Reaction of the Adrenal Medulla Under Low Dose Internal Irradiation of the Body). V. I. Kandror (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). Aug. 28, 1961. 6p.

Reaction of the adrenal medulla administrations of Na^{24} in small doses was studied. The adrenaline content of the blood was determined by the Shaw method. It was found that the administration of 0.25 μc of Na^{24} (the absorbed irradiation dose β = 2.5 rep) caused stimulation of the chromaffine tissue activity. The administration of 1 μc (the absorbed irradiation dose β = 9 rep) leads, after a short period of deep depression, to an increased adrenaline content in the blood. 5 μc (the absorbed irradiation dose β = 40 rep) caused a biphase stimulation of the adrenal medulla function. The part played by adrenaline in the onset of hormonic reactions of the adaptation syndrome is discussed. (auth)

30418 (A/AC.82/G/L.629) FLUORESTSENTNYE ISSLEDOVANIYA IZMENENII NIKLEOPROTEIDOV I IKH DERIVATOV V OBLUCHENNYKH KLETKAKH. (Fluoroscopic Study of Changes in the Nucleo-Proteins and Their Derivatives in Irradiated Cells). M. N. Meisel, E. M. Brumberg, T. M. Kondrat'eva, and I. Ya. Barskii (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). Aug. 28, 1961. 20p.

Vital and supravital fluorochroming followed by fluorescent microscopy permit observations of early disturbances in nucleoprotein cells after irradiation. Fluorescent microscopy of visual spectra showed initial and progressive physico-chemical changes of diaminoacredine fluorochromes, their separation from chromate structure, and depolymerization in cell nuclei. Intense ultraviolet and x radiation rapidly weaken the ultraviolet autofluorescence of cells, organs, and blood plasma resulting from photo- and x-ray chemical processes. The ultraviolet and autofluorescence luminosity and spectra of radiosensitive cells change after x radiation. The changes must be related to the ribonucleic cell condition. (R.V.J.)

30419 (A/AC.82/G/L.630) ODEISTVII RENTGENOVSKOGO OBLUCHENIYA NA OKISLITEL'NOE FOSFORILIROVANIE V MITOKHONDRIYAKH RASTENII. (The Effect of Exposure to X-Rays on the Oxidizing Phosphorylation in Plant Mitochondria). N. M. Sisakyan and V. Ya. Kalacheva (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). Aug. 28, 1961. 11p.

A pronounced depression of oxidizing phosphorylation was observed following plant irradiation with 300 r. Data indicate a sharp disturbance in the process of oxygen uptake in irradiated plant cells and conversion of inorganic phosphorus into phosphoro-organic compounds. Changes in inorganic phosphorus esterofication are much more pronounced than changes in oxygen uptake. (R.V.J.)

30420 (A/AC.82/G/L.632) ZNACHENI REGENERATSIONNYKH PROTSESSOV V REAKTSII TKANEI NA OBLUCHENIE. (The Significance of Regenerative Processes in Tissue Reaction to Irradiation). G. S. Strelin (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). Aug. 28, 1961. 7p.

Ordinarily, reduced dosage and prolonged exposure time results in considerable decreases in morphological injuries in tissues with strongly expressed physiological regeneration. This is postulated to be due to prevailing reparation action. In tissues with low physiological regeneration, radiation injury depends mostly on the dose rate. These tissues accumulate radiation injuries due to weak reparative ability. (R.V.J.)

30421 (A/AC.82/G/L.633) IZMENENIYA USLOVNOREFLEKTORNOI DEYATEL'NOSTI SOBAK, VYZVANNYE KHRONICHESKIM OBSHCHIM OBLUCHENIEM PREDEL'NO DOPUSTIMOI DOZOI RENTGENOVYKH LUCHEI. (Changes in the Conditioned Reflex Activity of Dogs Induced by Chronic General Exposure to Maximum Permissible Doses of X-Rays). L. I. Kotlyarevskii and K. N. Lyubimkina (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). Aug. 28, 1961. 9p.

The effects of chronic exposure to x radiation doses of 0.05 r on the higher central nervous system were studied in four dogs. It is shown that single or a few exposures do not change the cortex dynamics, while chronic exposure does affect the activity of the higher central nervous system. Under the conditions of the experiment, the changes had a rather functional reversible character. (R.V.J.)

30422 (A/AC.82/G/L.635) O PODAVLENII REGENERATSIONNYKH PROTSESSOV V KOSTI PRI RAZLICHNYKH USLOVIYAKH OBLUCHENIYA ZHIVOTNYKH. (The Suppression of Regenerative Processes in the Bones of Animals under Various Conditions of Irradiation). G. S. Strelin and E. M. Pil'shchik (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). Aug. 28, 1961. 15p.

Histological studies were made of the regenerative ability of bones in mature white rats exposed to various irradiation conditions. Gamma or x rays in doses of 1000 to 1500 r considerably depresses post traumatic regeneration. The amount of the dose play the main role in bone-tissue reactions. The tissue of mature animals has a low reparative ability in radiation injury and retains the damage for long periods. (R.V.J.)

30423 (A/AC.82/G/L.638) SPEKTROFOTOMETRICHESKOE I RADIOMETRICHESKOE ISSLEDOVANIE PREPARATOV DEZOKSIRIBONUKLENNOVOI KISLOTY, VYDELENNYKH IZ PECHENI KRYS POSLE PORAZHENIYA STRONTSIEM-90. (Spectrophotometric and Radiometric Study of Desoxyribonucleic Acid Compounds Extracted from the Liver of Rats Affected by Strontium-90). M. S. Uspenskaya (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). Aug. 28, 1961. 6p.

Solutions of DNA liver preparations from rats damaged by Sr^{90} (balanced with Y^{90}) absorb UV at 261 mμ less intensively; the greatest decrease of optical density in DNA solutions is observed 5 hours after the application of radioactive agents. Preparations of highly polymeric DNA extracted from the rat liver in an hour, five hours, and in 1 or 3 days after the application of Sr^{90} (+Y^{90}) possessed radioactivity with maximal DNA radioactivity 5 hours after injection. Maximal radioactivity of the DNA protein component in the liver is observed three days after exposure. The greatest accumulation of radioactive agents in a liver takes place 5 hours after they get into an organism. DNA

of the preparation, protein DNP, and intact liver tissue radioactivity after damage with Sr^{90} ($+Y^{90}$) is conditioned by the presence in these preparations of both Sr^{90} and Y^{90}; the relationship between these radioactive elements in the investigated preparations alters depending on the period of observation. (auth)

30424 (A/AC.82/G/L.641) OSOBENNOSTI KHRONICHESKOGO PORAZHENIYA, VYZVANNOGO STRONTSIEM-90. (The Characteristics of Chronic Injuries Caused by Strontium-90). D. I. Zakutinskii and L. N. Burykina (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). Aug. 28, 1961. 27p.

Data are presented on chronic injuries induced in dogs by Sr^{90} doses of 0.0002 to 0.02 μc/kg/day for 4 to 7 years. In chronic cases both the skeleton and soft tissue participate in the uptake. The central nervous system and neuroendocrine systems react earlier than the blood. The lower the dose the longer is the latent period of injury. However, even when exposure is terminated pathological processes continue. The life span of progenies from radiation injured dogs (0.02 to 0.2 μc) is shorter than from normal animals. The progenies exhibit weakness in the central nervous system, heart vessels, and blood system. (R.V.J.)

30425 (A/AC.82/G/L.645) K VOPROSY O KHARAKTERISTIKE SINTEZA BELKOV V ORGANOIDAKH KLETOK TAKANEI NORMAL'NYKH I OBLUCHENNYKH BELYKH KRYS. (Albumin Synthesis in the Organoids of Tissue Cells of Normal and Irradiated White Rats). L. I. Il'ina and R. V. Petrov (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). Aug. 28, 1961. 4p.

Two labeled amino acids, methionine-S^{35} and tyrosine-C^{14}, were incorporated into the albumin of nucleic cells, mitochondria, microsomes, and plasma of the liver and small intestine of male white rats weighing 180 to 210 g. The ratio of S^{35}-methionine and C^{14}-tyrosine in total tissue albumin in normal rats was 1.6 to 3.5. Acute radiation sickness did not alter the ratio. The ratio of S^{35}-methionine to C^{14}-tyrosine in total albumin microsome cells of both tissues is sharply changed. In the liver it is 0.7 and in intestine, 0.9. (R.V.J.)

30426 (A/AC.82/G/R.201) SOME RESULTS OF A STUDY OF THE BONE SYSTEM AFTER INJURY BY RADIOACTIVE STRONTIUM [N. N. Litvinov]. (Akademiya Meditsinskikh Nauk S.S.S.R.). [nd]. 14p.

A description of skeletal changes from the effects of chronic injury by Sr^{90} is presented. It was found that Sr^{90} produces chronic injuries in dogs injected intravenously with doses of 0.1, 0.15, and 0.4 mc/kg of weight and in rats injuries were sustained by intraperitoneal injections of 0.4 mc/kg of weight. (J.R.D.)

30427 (NARF-61-32T) THE DEVELOPMENT OF A SYSTEM FOR CONTINUOUS MEASUREMENT OF VISCOSITY IN A NUCLEAR RADIATION FIELD. E. T. Smith (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Forth Worth, Tex.). Sept. 11, 1961. Contract AF33(600)-38946. 37p. (FZK-9-156)

A method for the continuous monitoring and recording of the viscosity of a fluid while it is being irradiated was developed. This method utilizes a commercially produced viscometer that operates on the vibrating-reed principle and involves the adaptation on this instrument and its associated apparatus for use with a nuclear reactor test system. Continuous curves of viscosity vs. time were recorded during two irradiation experiments. Accuracy of the data was well within the usual limits placed upon continuous viscometers. (auth)

30428 (NAS-NRC-Pub-888) RESEARCH IN RADIOTHERAPY APPROACHES TO CHEMICAL SENSITIZATION. Proceedings of an Informal Conference, Carmel, California, May 6-8, 1960. Robert F. Kallman, ed. (National Research Council. Committee on Nuclear Science). 1961. 284p.

Nuclear Science Series Report Number 35.

Nineteen papers presented at the Conference on Research in Radiotherapy Approaches to Chemical Sensitization are given. Sixteen separate abstracts were prepared. Those topics not covered by separate abstracts include cancer chemotherapeutic approaches with particular reference to nucleic acid metabolism, perfusion techniques for local administration of cancer chemotherapeutic agents, and plans for unified staging and cooperative reporting of certain types of neoplastic disease. (M.C.G.)

30429 (NAS-NRC-Pub-888(p.1-9)) SOME ASPECTS OF CELLULAR RADIOSENSITIVITY AS REVEALED BY EXPERIMENTAL RADIOBIOLOGY. Quantitative Experimental Approaches to the Study of Cellular Radiobiology. Henry I. Kohn (California. Univ., San Francisco. Medical Center).

An elementary model of a cytologic radiation effect is considered. Analyses of the dose-effect curve from the point of view of the target theory are discussed. The fate of mice four weeks after whole-body x-ray treatment was studied as an example of how the target theory may be applied. HeLa cells from human cancer were used as an example in which there is more than one target. (M.C.G.)

30430 (NAS-NRC-Pub-888(p.10-29)) TIME-DOSE FACTORS IN THE IRRADIATION OF MAMMALIAN CELLS IN VITRO. Mortimer M. Elkind (National Institutes of Health, Bethesda, Md.).

Studies were carried out with mammalian cells surviving irradiation to determine if the progeny of such cells would indicate the fact that they had received sublethal damage by inheriting radiation properties which were different from the parental population. Survival and two-dose recovery curves were determined. It was found that instead of having a survival curve which would be exponential starting from the survival corresponding to their first dose, the cells that undergo repair return to a survival curve which is similar in shape to the original survival curve. It was concluded that mammalian cells in clusters have a total probability of survival which represents the composite sum of the individual survival probabilities of the number of cells in the cluster. It is shown that surviving cells appear to be capable of repeated cycles of damage and repair and that initially irradiated cells display sensitivity independence. The experimental cell culture data were projected to the problem of fractionated tumor therapy. It was concluded that the treatment course for a maximum differential effect can be predicted providing the radiation response parameters of the malignant and normal tissue are known. (M.C.G.)

30431 (NAS-NRC-Pub-888(p.30-48)) SOME ASPECTS OF THE TIME-DOSE RELATIONSHIP IN SPONTANEOUS AND TRANSPLANTED MOUSE TUMORS IRRADIATED IN VIVO. Robert F. Kallman (Stanford Univ., Calif. School of Medicine).

Experiments were carried out to provide information about recovery rates of mouse tumors after irradiation. All experiments were done with inbred mice of the C3H/Crgl strain. The tumors were of two kinds: transplants of hepatoma 134 and spontaneous mammary adenocarcinomas. The x radiation was administered by the split dose method and 1200 r was chosen as the conditioning dose. Recovery

data for the transplanted hepatoma showed that the degree of radiosensitivity conferred by the conditioning dose decays monotonically with time. The results for the spontaneous tumors were quite different. It was found that the conditioning effect is practically gone if the tumors receive their second dose at 2 days, but something happens between the second and fourth day that, in effect, resensitizes the tumor. (M.C.G.)

30432 (NAS-NRC-Pub-888(p.49-69)) SOME RADIATION EFFECTS ON MAMMALIAN CELLS IN TISSUE CULTURE. Gordon F. Whitmore (Toronto. Univ.).

Experiments were carried out on L cell line mouse fibroblasts grown in tissue culture in order to study the life history of a cell and to determine radiation effects on each part of the cell cycle. Tracer techniques showed that DNA synthesis took up 30% of the 20 hr cell cycle and that RNA is synthesized throughout the entire cycle. The principal effect of radiation was the induction of a block in G_2, the period between the DNA synthetic period and mitosis, and most of the findings of mitotic delay, division delay, and reduced DNA synthesis during the first post-irradiation cycle could be traced to this source. Finally, however, this block was at least partially removed and the cells again entered mitosis. (M.C.G.)

30433 (NAS-NRC-Pub-888(p.70-81)) MECHANISMS OF CHROMOSOME BREAKAGE AND REPAIR. Sheldon Wolff (Oak Ridge National Lab., Tenn.).

The mechanisms of radioinduced chromosome breakage and rejoining were investigated using the methods of the target theory. A dose of 600 r was given to the seeds of Vicia faba in vacuo and then at least 75 min later a second dose, usually 300 r, was given in air. It was found that breaks in the chromosomes would rejoin in 30 min. However, anything that inhibited metabolism would keep breaks open and increase the sensitivity of the cell. Methods of increasing the sensitivity of cells that are not in the interphase but are rapidly dividing were also studied. It was concluded that chromosomal damage accounts for a large portion of but not all of the radioinduced cell deaths that occur at low doses. (M.C.G.)

30434 (NAS-NRC-Pub-888(p.104-16)) THE ROLE OF DNA IN CELLULAR RADIATION INJURY. Henry S. Kaplan (Stanford Univ., Calif. School of Medicine).

The genetic role of DNA in the cell and effects of radiation on this role were investigated. Evidence that the cytocidal action of radiation involves DNA, radiation to the DNA molecule, and the role of lesions affecting DNA integrity in radioinduced cell death are discussed. (M.C.G.)

30435 (NAS-NRC-Pub-888(p.117-26)) COMBINED CHEMO- AND RADIOTHERAPY: HISTORICAL AND BASIC ASPECTS. The Parameters of Combined Therapy. Oliver C. A. Scott (Mount Vernon Hospital, Northwood, Middx., England).

The combination of chemotherapeutic agents and x rays for treatment of tumors was considered. The terms, additivity, sensitization, synergism, and therapeutic synergism are discussed. (M.C.G.)

30436 (NAS-NRC-Pub-888(p.127-37)) THE NATURE OF EARLIER EVIDENCE OF CHEMICAL RADIOSENSITIZATION. M. M. Kligerman (Yale Univ., New Haven. School of Medicine).

Attempts at improving the results of experimental and clinical radiotherapy by means of chemicals are reviewed. Applications of colloidal lead, activated fluorescein, colchicine, distilled water, bacterial toxins, cyanides, hormones, synthetic vitamin K, urethane, folic acid analogs, and porphyrins are discussed. (M.C.G.)

30437 (NAS-NRC-Pub-888(p.138-49)) SOME EXPERIMENTAL EVIDENCE FOR CHEMICAL ENHANCEMENT OF RADIATION RESPONSE IN VITRO. Malcolm A. Bagshaw (Stanford Univ., Calif. School of Medicine).

Studies were carried out to determine if the radiosensitivity of the HeLa cells may be increased by applying certain chemical agents before or after irradiation. The Puck tissue culture technique was used as the test system. The sensitivity of the HeLa cells to irradiation was increased by at least a factor of 1.4 when the cells were irradiated and subsequently incubated in an invironment which contained 5-fluorouracil. Preliminary experiments suggested that azaserine may have influenced the sensitivity of the cells although rigorous statistical evaluation was not obtained. In preliminary experiments with 5-bromodeoxyuridine, alone and in combination with 5-fluorouracil, an increase in radiosensitivity was suggested but statistical evaluation was incomplete. (M.C.G.)

30438 (NAS-NRC-Pub-888(p.150-61)) EXPERIMENTAL STUDIES WITH THE FLUOROPYRIMIDINES. Charles Heidelberger (Wisconsin, Univ., Madison).

Studies were carried out with fluoropyrimidines to determine their effects on tumors. The compound 5-fluorouracil was prepared along with 5-fluorouridine and 5-fluoro-2'-deoxyuridine. Tracer studies showed selective localization of 5-fluorouracil and its metabolites in the tumor of mice. Most normal tissues were able to degradate this compound to less toxic ones, but the tumors were not able to do so. In human tumors however, there was no greater selectivity of localization in the tumor than in the intestinal mucosa and consequently significant therapeutic results in humans could not be achieved without producing toxicity to the bone marrow cells and intestinal tract. The anabolic metabolism and biochemical effects of these compounds were studied. It was found that complete regressions of established tumors in mice were produced by the combination of repeated treatments with fluorouracil and a single x-ray dose of 1500 r, whereas this dose of radiation alone stopped tumor growth but did not cause regression, and the low dose of drug alone was ineffective. (M.C.G.)

30439 (NAS-NRC-Pub-888(p.162-80)) THE RADIOSENSITIZING EFFECT OF THE HALOGENATED THYMIDINE ANALOGS. Waclaw Szybalski (Wisconsin. Univ., Madison).

Studies showed marked radiosensitization of replicating human cells which had incorporated halogenated thymidine analogs into the DNA molecules. The effects of "unifilar" and "bifilar" labeling of DNA and the relationship between DNA labeling and radiosensitivity were studied. The modification of the radiosensitivity of this molecule by halogenation was found to depend both on an intrinsic increase in radiation lability and on partial or complete loss of the DNA molecules to undergo the process of enzymatic or non-enzymatic repair. Possible implications of this radiosensitization phenomenon for the radiotherapy of tumors are discussed. (M.C.G.)

30440 (NAS-NRC-Pub-888(p.181-4)) THE EFFECT OF RADIATION UPON HAIR GROWTH IN THE MOUSE, AND ITS MODIFICATION BY HYPOTHYROIDISM AND ACTINOMYCIN D. Melvin L. Griem (Chicago. Univ.).

The effects of radiation on the growth of hairs on mice were studied. The hairs were treated with varying doses of radiation and the metabolic state of the animals was also

varied. A hypothyroid and hyperthyroid group were prepared. Actinomycin D when administered simultaneously with radiation had no effect. When administered before or after irradiation results similar to those with hypothyroid mice were obtained. (M.C.G.)

30441 (NAS-NRC-Pub-888(p.185-92)) COMBINED CHEMO- AND RADIOTHERAPY: CLINICAL ASPECTS. Clinical Experiences with 5-Fluorouracil and Related Compounds in Combination with Radiotherapy. Halvor Vermund (Wisconsin. Univ., Madison).

Data on the effects of combined x-ray therapy and chemotherapy with fluorinated pyrimidines are presented. Two types of mouse tumors were treated: sarcoma 180 and Bittner Z strain mammary Carcinomata in the second transplant generation. Treatment with 5-fluorouracil and irradiation increased the survival of the animals significantly. Complete tumor regression of sarcoma 180 was obtained in about 50% of the animals given the combined chemo- and radiotherapy, but not in a single animal with either alone. The other tumors continued to grow after the combined therapy, but some beneficial effects were observed. Most patients treated had very far advanced cancer. The combined therapy caused a regression of the tumor, but in most cases this was only temporary. Combined therapy was studied on bronchiogenic carcinoma in comparison with radiotherapy alone with negative results. (M.C.G.)

30442 (NAS-NRC-Pub-888(p.193-8)) CLINICAL AND EXPERIMENTAL STUDIES WITH ACTINOMYCIN D AND RADIATION. G. J. D'Angio (Children's Hospital, Boston).

Experiments with actinomycin D and x radiation are described. X-ray responses in normal human tissues were potentiated by actinomycin D when used in conjunction with irradiation. The reactions developed at an accelerated pace and healed more rapidly than comparable effects produced by x rays alone. Actinomycin D reactivated latent radiation effects in tissues previously irradiated but which had returned to normal appearance. In children the response of some tumors to x irradiation was apparently enhanced by actinomycin D. The best results were obtained with Wilms' tumor. The enhancement of x-ray effects on normal human skin was substantiated by a series of experiments using mice. In mice, better tumor regression and survival were obtained when the Ridgway Osteogenic sarcoma was treated by the combined method. (M.C.G.)

30443 (NAS-NRC-Pub-888(p.199-209)) CLINICAL RESULTS IN THE TREATMENT OF RETINOBLASTOMA WITH TEM AND RADIATION. Norah duV. Tapley (Columbia-Presbyterian Medical Center, New York).

A comparison was made of cases of retinoblastoma treated with high radiation doses and the more recent cases treated with lower doses, some with and some without the addition of triethylenemelamine (TEM). It was found that 20% of the patients in the heavily radiated group had useful vision 10 years or longer after the completion of the radiotherapy. Many of the 80% failures were due to radiation sequelae. Of the moderately radiated group, 60% had control of tumor growth with initial therapy and there were no failures attributable to radiation damage. If the successfully retreated cases of this group were omitted from the failures, a reasonable expectancy of retaining useful vision was seen in 63.5%. In selected favorable cases, including those treated with and without TEM, the per cent of failure in controlling the tumor was seen in only 7%, with 93% of these patients retaining vision at three years or more after treatment. No conclusion was reached on whether TEM addition contributed to tumor control and maintenance of vision. (M.C.G.)

30444 (NAS-NRC-Pub-888(p.210-18)) SOME OBSERVATIONS OF COMBINED THERAPY WITH 5-FLUOROURACIL AND RADIATION, WITH SPECIAL REFERENCE TO OROPHARYNGEAL CARCINOMA. Gilbert H. Fletcher (Texas. Univ., Houston. M. D. Anderson Hospital and Tumor Inst.).

An investigation was made of the effectiveness of the combination of 5-fluorouracil and radiation in patients with advanced squamous cell carcinomas of the head and neck. Five days of treatment with 15 mg per kiloweight of 5-fluorouracil were carried out and then irradiation started. Additional doses of 5-fluorouracil were planned but were abandoned because of toxicity. The quantitative benefit of this combined treatment seemed to be of the order of 20 to 25%. (M.C.G.)

30445 (NP-10650) QUARTERLY PROGRESS REPORT NO. 40 [ON MEDICAL RESEARCH]. (Chicago. Univ. Air Force Radiation Lab.). July 15, 1961. Contract AF41(657)-252. 123p.

Separate abstracts have been prepared on the 7 sections of this report. (C.H.)

30446 (NP-10650(p.1-14)) THE EFFECTS OF IONIZING RADIATIONS ON THE BIOCHEMISTRY OF MAMMALIAN TISSUES. I. EFFECTS OF SINGLE AND REPEATED DOSES OF SULFUR-CONTAINING RADIOPROTECTIVE AGENTS ON INTERMEDIARY CARBOHYDRATE METABOLISM. Kenneth P. DuBois and Ann B. Raymund (Chicago. Univ. Air Force Radiation Lab.).

A study was initiated to obtain information on the cumulative toxicity of 2-aminoethylisothiuronium (AET). Rats were given 100, 200, or 300 mgm/kgm/day of AET dibromide and sacrificed 24 hr after various total doses of the drug. The oxidation of pyruvate by liver and kidney homogenates was measured. No inhibitory effect on the oxidation of pyruvate by liver was observed and daily doses of 100 mgm/kgm had no effect on this reaction in kidney. However, higher daily doses, particularly 300 mgm/kgm, caused substantial inhibition of the oxidation of pyruvate by kidney indicating that the cumulative toxicity is due, at least in part, to kidney damage. Measurements of the effects of a new radioprotective agent, mercaptoethyldithiocarbamate, on sulfhydryl enzymes demonstrated that relatively high concentrations of this compound inhibit alpha-keto acid oxidases and succinic dehydrogenase in vitro. However, a maximum tolerated dose (400 mgm/kgm) had no significant effect on these enzymes in vivo and it did not affect the rate of glycolysis and respiration of brain homogenates. The latter reactions were tested because the gross symptoms of poisoning by this compound were suggestive of an action of the central nervous system. A comparison of the effects of mercaptoethylamine, mercaptoethyldithiocarbamate, and dimethylammonium dimethyldithiocarbamate on the oxidation of glucose by tissue slices showed that maximum tolerated doses of all of the compounds had no appreciable effect on this process in spleen, liver, kidney and thymus glands. (auth)

30447 (NP-10650(p.15-31)) THE EFFECTS OF IONIZING RADIATIONS ON THE BIOCHEMISTRY OF MAMMALIAN TISSUES. II. THE EFFECT OF VARIOUS RADIOMIMETIC AND CYTOTOXIC AGENTS ON THE ENZYME ACTIVITIES OF CERTAIN TISSUES OF RATS. Bernard E. Hietbrink, Ann B. Raymund, and Kenneth P. DuBois (Chicago. Univ. Air Force Radiation Lab.).

Measurements of the effect of 1 mgm/kgm of colchicine on the cholinesterase activity of the small intestine and on

the adenosine triphosphatase activity of the spleen and thymus glands were conducted. The results indicate that colchicine caused a decrease in enzyme activity of the intestine that was evident at 12 hr, reached a maximum at 18 to 24 hr and returned toward normal after 4 days. Colchicine produced an increase in the enzyme activity of the thymus glands similar to but somewhat more delayed than that caused by HN1, HN2, and x irradiation while it did not significantly affect the adenosine triphosphatase activity of the spleen. Several sulfur-containing radioprotective compounds were tested for ability to reduce the colchicine-induced decrease in the cholinesterase activity of the intestine. Mercaptoethylamine was the most effective agent tested. A substantial beneficial effect was also provided by glutathione but DMDTC and cysteine appeared to enhance the effect of colchicine on the intestine. Measurements of the effect of 10 mgm/kgm and 15 mgm/kgm of chlorambucil on the acetylcholinesterase activity of the small intestine indicated that chlorambucil caused a decrease in cholinesterase activity that was not strictly dose dependent but similar to that produced by the nitrogen mustards and x ray. Adenosine triphosphatase assays on the spleens and thymus glands illustrated that the increase in enzyme activity of the spleen produced by chlorambucil is similar to that produced by sublethal doses of HN1, HN2, and radiation and that increases in enzyme activity observed in the thymus glands do not reach a maximum as rapidly as those caused by x irradiation. Administration of mercaptoethylamine, glutathione, cysteine, or DMDTC before injection of chlorambucil did not reduce the damaging effects of chlorambucil in the hematopoietic tissues. DMDTC, cysteine, and glutathione provided limited protection against the decrease in cholinesterase activity induced by chlorambucil but mercaptoethylamine failed to prevent the decrease in enzyme activity caused by this radiomimetic agent. Fifty mgm/kgm of myleran caused a decrease in the acetylcholinesterase activity of the intestine similar to radiation and the alkylating agents. The maximum increase in adenosine triphosphatase activity of the spleen and thymus glands caused by this agent does not occur until after an interval of more than one week. Preliminary studies indicate that 75 mgm/kgm of 6-mercaptopurine did not significantly change the enzyme activity of the tissues tested when administered three days before assay. Substantial changes were observed in the enzyme activity of the thymus glands and intestine of rats sacrificed five days after 75 mgm/kgm of 6-mercaptopurine. (auth)

30448 (NP-10650(p.32-40)) THE EFFECTS OF IONIZING RADIATIONS ON THE BIOCHEMISTRY OF MAMMALIAN TISSUES. III. THE INFLUENCE OF ADRENAL DEMEDULLATION, EPINEPHRINE AND METHAMPHETAMINE ON RADIATION INJURY IN RATS. Esmat A. Ezz and Kenneth P. DuBois (Chicago. Univ. Air Force Radiation Lab.).

Adrenal demedullation did not affect the susceptibility of the spleen or intestine of male or female rats to injury by x irradiation as measured enzymatically. These findings indicate that the adrenal medulla does not have a significant role in acute radiation injury to these tissues. Epinephrine at a dosage level of 1 mgm/kgm given five minutes before exposure to 400 r of x irradiation afforded 62% protection against radiation injury to the spleen but it did not protect the intestine. Methamphetamine given at a dose level of 20 mgm/kgm 15 minutes before exposure to 400 r of total-body x irradiation afforded 22% protection against radiation injury to the spleen. The radioprotective activity of these two aromatic amines is proportional to their vasoconstrictor activity. Castration of adult male rats did not alter the adenosine triphosphatase activity of the spleens or the acetylcholinesterase activity of the small intestines of unirradiated animals. Castration had no effect on radiation-induced injury to the spleen or small intestine. (auth)

30449 (NP-10650(p.98-106)) INFLUENCE OF EXPOSURE TO LOW LEVELS OF GAMMA AND FAST NEUTRON IRRADIATION ON THE LIFE SPAN OF ANIMALS. I. EFFECT OF AGING AND RADIATION EXPOSURE ON ADAPTATION TO DECREASED BAROMETRIC PRESSURE AND GLUCOSE TOLERANCE IN MICE. A. Sandberg and J. Doull (Chicago. Univ. Air Force Radiation Lab.).

Measurements of the response of the rectal temperature of young and old CF_1 female mice to simulated altitude exposure demonstrated that such determinations may provide a satisfactory parameter for evaluating aging in this species. Aged mice lack the ability of younger animals to adapt to the repeated low barometric pressure exposures and thus continue to exhibit the decrease in rectal temperature with subsequent exposures. The glucose tolerance curves of young and old CF_1 female mice were compared at various intervals following the administration of a test dose of glucose. It was found that the aged mice exhibit an impaired glucose utilization and that radiation exposure in the sublethal range also decreases the ability of both the young and old animals to eliminate excess blood glucose. (auth)

30450 (NP-10650(p.107-21)) INFLUENCE OF EXPOSURE TO LOW LEVELS OF GAMMA AND FAST NEUTRON IRRADIATION ON THE LIFE SPAN OF ANIMALS. II. PROTECTION AGAINST CHRONIC RADIATION LETHALITY IN MICE. J. Doull, V. Plzak, and M. Root (Chicago. Univ. Air Force Radiation Lab.).

Studies have been carried out to determine whether various treatments capable of reducing the lethal effects of acute radiation exposure can also be used to reduce the lethal effects of chronic x-ray exposure in mice. The pre-irradiation administration of serotonin at a dosage level of 90 mgm/kgm/day did not alter the mortality response of CF_1 female mice given daily x-ray exposures at the rate of 50 r or 100 r/day to death. The pre-irradiation administration of 2-aminoethylisothiourea at a dosage level of 20 mgm/kgm did not alter the mortality response of CF_1 female mice given daily x-ray exposures at the rate of 50 r or 100 r/day to death. The pre-irradiation administration of p-aminopropiophenone increased the mortality and shortened the median survival time (ST_{50}) of CF_1 female mice exposed to 40 r and 100 r of x irradiation daily to death. Partial body shielding during daily x-ray exposure decreased the mortality and increased the ST_{50} of chronically irradiated mice. Shielding of the thorax or abdomen was more effective than shielding of the head or pelvic regions. Shielding of the thorax (from neck to lower end of the sternum) is almost as effective in preventing chronic radiation lethality in x-rayed mice as is abdominal shielding (lower end of sternum to the pubic region). Increasing or decreasing the environmental oxygen level during chronic radiation exposure does not appear to markedly alter the mortality response of CF_1 female mice exposed to 50 r or 75 r of x irradiation daily to death. These studies support our hypothesis that the hematopoietic system is of greater importance in the lethal effects of acute radiation exposure than in chronic radiation expo-

sure and provide additional evidence that another organ system (possibly the liver) is responsible for at least part of the manifestations of chronic radiation injury. (auth)

30451 (NP-10730) BIOLOGICAL AND MEDICAL ASPECTS OF IONIZING RADIATION. TASK NO. 1. METABOLISM IN RADIATION INJURY. Period Covered, July 1, 1960–June 30, 1961. Laurence M. Corwin, Bhupendra P. Doctor, Olive E. McElroy, E. M. Beier, William J. Campbell, William C. Purdy, and Edward C. Knoblock (Walter Reed Army Medical Center. Inst. of Research, Washington). 76p.

Information on the various projects is presented in abstracts. Projects reported include metabolism in radiation injury, clinical uses of radioisotopes, dosimetry, effects of whole-body irradiation in man, immunological response following total body radiation. Methods of casualty assessment in nuclear warfare, whole body counting facility, radiation effects on animals in germ-free environment, prevention and care in cases of decubitus ulcers, chemical protection against total body radiation, and mechanisms of protection and recovery in cellular radiation injury. (J.R.D.)

30452 (TID-13098) INVESTIGATIONS ON THE CYTOGENETIC EFFECTS OF RADIATION. Progress Report, June 1, 1960–May 31, 1961. Norman H. Giles (Yale Univ., New Haven). Contract AT(30-1)-872. 54p.

Progress is reported in studies of interallelic complementation at various genetic loci in Neurospora. Detailed studies were completed on the ad-8 locus which controls the enzyme adenylosuccinate synthesis. A comparison of the complementation map with the genetic map shows a general co-linearity between the two maps, with several significant exceptions. These exceptions suggest the existence of a particular genetic region of this locus related to each of the three basic complementation units. The analysis of complementation at the ad-4 locus controlling the enzyme adenylosuccinase was continued and data are included. A preliminary genetic map localizing complementing mutants was established and found to be generally co-linear with the complementation map. Studies of forward and reverse mutations induced by chemical mutagens were continued and preliminary results are included. Data are also included from studies of gene conversion employing mutants at the pan-2 locus. A search was made for systems suitable for detailed studies of gene protein relationships. (C.H.)

30453 (TID-13186) THE BIOLOGIC EFFECTS OF RADIATION ON THYROID TISSUE. Annual Progress Report, September 15, 1960 through September 14, 1961. Oliver Cope (Massachusetts. General Hospital, Boston). June 17, 1960. Contract AT(30-1)-667. 11p.

Observations collected in this period in the course of a follow-up investigation of thyrotoxic patients treated with radioiodine are summarized. Out of a total of 1786 patients, two tumors were found, one benign and the other malignant, and their cases are discussed in detail. Results of studies of possible leukemia and genetic effects of radioiodine are negative. (D.L.C.)

30454 (TID-13216) A QUANTITATIVE STUDY OF LIFETIME SICKNESS AND MORTALITY AND PROGENY EFFECTS RESULTING FROM EXPOSURE TO PENETRATING IRRADIATION. Summary of Progress and Contemplated Work Program, Fiscal Year 1961-62. John W. Gower and Janice Stadler (Iowa State Univ. of Science and Tech., Ames). Contract AT(11-1)-107. 113p.

Progress is reported in studies on the effects of radiation on life shortening and aging. A theory and supporting evidence is presented to account for primary factors affecting radiation life-shortening and senescence. Data are included from studies on the effects of radiation on the interrelations of reproductive performance and inheritance in mice, the effects of inheritance on the number of litters, the effects of radiation and genotype on the life spans of mice, effects of radiation on chromosomes, the cause of genetic male sterility following irradiation, the effects on continuous Co^{60} gamma irradiation through 10 generations on viability in the mouse, the production of a new radiation-induced dwarf mouse, the effects of x irradiation on physical activity of inbred and hybrid mice, the effects of irradiation on brain functioning, the effects of irradiation on disease resistance and immunity in mice, and sex determination as illustrated by x-ray induced chromosomal and gene reorganization in Drosophila. (C.H.)

30455 (TID-13866) IRRADIATION EFFECTS ON THE CENTRAL NERVOUS SYSTEM. Progress Report, January 1, 1961 to date. Lloyd J. Roth (Chicago. Univ.). Oct. 2, 1961. Contract AT(11-)-847. 13p.

Blood brain barrier changes resulting from application of x irradiation to the isolated heads of rats were investigated utilizing such radioactively labeled compounds as I^{131}-human serum albumin, S^{35}-sodium sulfate, and the quaternary ammonium drug Aprobit. The rats were sacrificed by rapid immersion in a mixture of dry ice and acetone (–75 C). No significant change in the permeability properties of the blood brain barrier was detected for the human serum albumin or the sulfate in the irradiated rat brain at levels of 10000 r. The results are tabulated. (P.C.H.)

30456 (TID-13867) THE EFFECT OF NEUTRONS AND OTHER RADIATIONS ON OCULAR LENS. Progress Report [for contract period] January 1961–December 1961. V. Everett Kinsey (Kresge Eye Inst., Detroit). Contract [AT(11-1)-152]. 21p.

The transport of amino acids across the blood aqueous barriers, the capsule and epithelium of the lens, and some factors which affect the processes involved were studied. Investigations were also made of the relative concentration of free amino acids in the aqueous and vitreous humors, lens, and plasma of normal animals, and some experiments were performed in which the transport of potassium into the lens was determined. Carbon labeled alpha-amino isobutyric acid and other carbon-14 labeled compounds show that aspartic acid reduces the transport of flutamic acid, but not the basic amino acids. Three different mechanisms are involved in transporting amino acids into the lens. Elevated concentrations of glucose inhibit amino acid transport, and other sugars have similar effects. Evidence that naturally occurring amino acids are actively transported across the ciliary epithelial cells is shown. An incubation medium was developed which allows a lens dispersion to consume glucose and produce lactate at rates which are accepted as normal for intact lenses incubated in Tyrode's solution. The use of this medium in the study of fructose production in the lens culminated in a report showing the source of fructose in the lens, the mechanism by which it is formed, and speculation as to the function of this mechanism. The relative concentration of free amino acids in aqueous humor in the posterior and anterior chambers, vitreous humor, and plasma of rabbits was determined by ion exchange chromatography. (P.C.H.)

30457 (UCD-101) THE EFFECTS OF X-RADIATION ON WORK CAPACITY AND LONGEVITY OF THE DOG. TENTH ANNUAL PROGRESS REPORT. A. C. Andersen

(California. Univ., Davis. School of Veterinary Medicine). July 1961. Contract AT-11-1-GEN-10. 124p.

One decade has past since this project began with the objective of determining the late or long-term effects of total-body x-irradiation in the dog. Emphasis has been placed on evaluating kennel environment and obtaining clinical data. These two factors are related and play an important role in life-span measurements. Seventy-three percent of the experimental beagles are alive as they approach 8 years old. Under natural conditions, only 22% of beagles are still alive at that age. Establishing an optimum environment for these dogs makes the study of long-term effects of radiation more significant. Normal fluctuations in peripheral blood values mask any supposedly long-term effect; neither leukemoid nor leukemic responses have been observed. Reproductive studies continue to indicate that fertility is not appreciably affected by total-body x-irradiation. Even females that survived a near-lethal exposure ($LD_{60/30}$) maintained fertility 5 years old. Since these results conflict with comparable studies in mice, a possible species difference is being explored. Sixty dogs exposed to 250 r either shortly after birth or at puberty will be bred over their life span. An increasing number of cancers among irradiated dogs is revealing a shortening of life span. Earlier deaths were attributed largely to infectious diseases and organ malfunction, but irradiated dogs surviving to 2500 days are succumbing to cancer. Benign tumors observed among controls are matched in irradiated dogs of comparable age by similar, but malignant, types causing death more rapidly. Results are included from other parameters of study, such as body weight and measurements, and studies of cardiovascular diseases. (C.H.)

30458 (UCD-102) EFFECTS OF IRRADIATION (X-IRRADIATION) ON REPRODUCTION IN FEMALE BEAGLES. PART I. THE EFFECT OF TOTAL-BODY X-IRRADIATION ON THE ESTROUS CYCLE OF BEAGLES. A. C. Andersen and F. Schultz. PART II. REPRODUCTION IN X-IRRADIATED FEMALE BEAGLES TO 4 YEARS OF AGE. A. C. Andersen, F. Schultz, and T. J. Hage. PART III. CONTINUAL REPRODUCTION OF X-IRRADIATED FEMALE BEAGLES. A. C. Andersen. PART IV. REPRODUCTION AFTER NEUTRON EXPOSURE. A. C. Andersen. Project Title: THE EFFECTS OF IRRADIATION ON WORK CAPACITY AND LONGEVITY OF THE DOG. (California. Univ., Davis. School of Veterinary Medicine). Aug. 1961. Contract AT(11-1)-GEN-10. 39p.

In 304 female beagles exposed at puberty to either 100 or 300 r x rays (250 Kv; 30 ma) and 57 controls, the rhythmic recurrence of estrus remained normal until the dogs attained 4 years of age. During this period, approximately one-half of the dogs whelped two litters; the irradiated groups equaled or bettered the controls. Another colony consisting of 11 controls and 7 x-irradiated (300 r) dogs were bred on each estrous period and demonstrated that irradiated dogs maintain fertility following successive matings. These experiments suggest that, until the advent of senility, dogs receiving x-ray exposures up to a median lethal dose are not affected in their reproductive capability. A limited number of beagles surviving a median lethal dose of fast neutrons (E max of 12 Mev) were fertile, but unable to whelp or lactate during the first 2 years after exposure, after which reproduction was normal. (auth)

30459 (UR-602) SOME PROPERTIES OF REPARABLE AND IRREPARABLE RADIATION INJURY. Henry A. Blair (Rochester, N. Y. Univ. Atomic Energy Project). Apr. 10, 1961. Contract W-7401-eng-49. 25p.

Data on mice exposed to protracted equal daily dosage or continuous dosage of external ionizing radiation are analyzed in terms of the reparable and irreparable components of the injury. It is concluded that recovery rate, at a given rate of exposure, does not change with duration of exposure. The irreparable fraction of the injury is greater, however, at the higher than at the lower daily dose rates in the range from 50 to 10 r per day. The results suggest that the irreparable fraction of radiation injury may continue to decrease as the daily dose rate becomes smaller. (auth)

30460 (UR-603) RESPONSE OF MICROWAVE TREATED DOGS TO IONIZING RADIATION. R. A. E. Thomson, W. J. Quinlan, S. M. Michaelson, W. J. Krasavage, L. T. Odland, and J. W. Howland (Rochester, N. Y. Univ. Atomic Energy Project). Sept. 14, 1961. Contract W-7401-eng-49. 13p.

One or more months after dogs were exposed to 2800 Mcycle/sec microwaves at field intensities of 100 and 165 mw/cm^2, they received ionizing radiation to the head (10,000 r); bilateral to the whole body (340 r); or lower body from the xiphoid process caudad (950 r). Normal dogs were subjected to similar ionizing radiation. Clinical response and mortality data are suggestive of a modified response to ionizing radiation in animals previously exposed to microwaves. (auth)

30461 (AEC-tr-4817) THE EFFECT OF SMALL RADIATION DOSES ON CHROMOSOME REARRANGEMENTS DURING THE IRRADIATION OF CELLS IN HUMAN EMBRYONIC TISSUE CULTURES. N. P. Dubinin, Yu. Ya. Kerkis, and L. I. Lebedeva (Lebedieva) (Akademiya Nauk S.S.S.R.). Translated from report A/AC.82/G/L.417. 1960. 11p.

This paper was previously abstracted from the original language and appears in NSA, Volume 15, abstract no. 15401.

30462 (AEC-tr-4826) APPEARANCE OF TRANSLOCATIONS AND GROWTH OF EMBRYONIC CELLS IN THE DROSOPHILA MELANOGASTER. V. G. Bogachenko and M. E. Lobashov. Translated by A. L. Monks (Oak Ridge National Lab., Tenn.) from Trudy Leningrad. Obshchestva Estestvoispytatelei, 65: 254-61(1936). 11p.

Two groups of Drosophila—a mature group and a group of 3-day-old larva—are exposed to 5000 r doses of x rays. The frequencies of various types of radiation-induced autosome translocations in these two groups are measured. It is found that the frequency is greater for mature cells; it is proposed that the frequency difference is caused by the presence of mutual attraction forces between homological loci that occur only in immature embryonic cells. (T.F.H.)

30463 STUDIES OF THE IRRADIATION PROTECTION EFFECT OF FETAL LIVER IN MICE. II. STORAGE BY FREEZING. John H. Githens, Paul N. Tschetter, M. Giovannella Moscovici, and William E. Hathaway (Univ. of Colorado Medical Center, Denver). Blood, 18: 344-8(Sept. 1961).

Various methods of freezing were evaluated for the preservation of the radiation protection effect in fetal mouse liver. The best results were obtained with tissue frozen slowly in glycerol to −80°C, stored at −50°C or lower, and thawed rapidly. Other variables such as the size of the tissue particles, the amount of serum in the freezing mixture, and the method of dilution did not influence the results. (auth)

30464 THE ETIOLOGIC ROLE OF RADIATION IN THE DEVELOPMENT OF LEUKEMIA. Eugene P. Cronkite

(Brookhaven National Lab., Upton, N. Y.). Blood, 18: 370-6(Sept. 1961).

A review is given on whether or not radiation causes leukemia, and the role it performs if it does. Several previous results are referred to and in some instances are evaluated. Both the medical and fall-out aspects are considered. It is concluded that it would be desirable to establish a radiation leukemia registry in some organization within the U. S. with the purpose of evaluating the likelihood of radiation as the etiologic agent. (P.C.H.)

30465 THE EFFECT OF TOTAL X-RAY IRRADIATION ON THE LEVEL OF γ-AMINOBUTYRIC ACID IN THE BRAIN. S. S. Musaelyan and I. A. Sytinskii (Pavlov Inst. of Physics, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 139: 994-5(Aug. 1, 1961). (In Russian)

White rats were given x-ray doses of 400, 800 and 1000 r. The animals were frozen whole in liquid oxygen 2, 3, 4, 6, 8, 9, 10 and 11 days after irradiation. An extract of the brain tissue was prepared, and the γ-aminobutyric acid (γ-ABA) content was determined spectrophotometrically at a wavelength of 512 mμ after separation of the γ-ABA by paper chromatography with a mixture of n-butyl alcohol–acetic acid–water (4 : 1 : 5) as an eluant. The average content of γ-ABA in normal rats was 18.9 ± 1.28 mg-%. Doses of 400 and 1000 r showed no change in the content of γ-ABA, but the 800 r dose showed an increase to 22 mg-% in γ-ABA content. It is believed that an increase in carboxylase activity in brain tissue during irradiation led to the accumulation of γ-ABA in the brain tissue. (TTT)

30466 THE TRANSAMINASE LEVEL IN THE BLOOD PLASMA OF MICE IRRADIATED WITH SINGLE AND REPEATED DOSES OF X-RAYS. M. Skalka (Inst. of Biophysics, Czechoslovak Academy of Sciences, Brno). Folia Biol. (Prague), 7: 275-80(1961). (In English)

In mice, as in other mammals, irradiation was followed by an increase in the level of glutamic–oxalacetic transaminase (GOT) and of glutamic–pyruvic transaminase (GPT) in the plasma. The maximum increase occurred eight hours after irradiation. Under the given experimental conditions, a second peak was found seven days after irradiation. Repeated irradiation led to a further increase in the transaminase level only when the interval between the two doses was four days. On repeating irradiation seven or ten days after the first dose, no increase occurred in the GOT level. The mechanism of this paradox reaction is discussed with reference to the findings in the literature. (auth)

30467 EFFECT OF A LOW TEMPERATURE ON THE DEVELOPMENT OF RADIATION INJURY IN EGGS OF THE SILKWORM BOMBYX MORI L. Š. Paulov (Comenius Univ., Bratislava). Folia Biol. (Prague), 7: 281-4(1961). (In English)

Experiments were made to determine whether the cooling of irradiated eggs during the diapause would moderate the effects of radiation in eggs of the silkworm. The degree of injury to the irradiated eggs was evaluated from the percentage of larvae hatched and from the time course of hatching. It was found that a low temperature moderated the effects of radiation. Injury was less when the eggs were irradiated before being placed in the refrigerator than when they were irradiated after being removed from the refrigerator. It is suggested that the difference in injury is related to metabolic changes. (P.C.H.)

30468 THE QUESTION OF THE RADIATION BURDEN OF PATIENTS IN FLUOROSCOPY. W. Schmitz (Universität, Munich). Fortschr. Gebiete Röntgenstrahlen u. Nuklearmed, 95: 86-97(July 1961). (In German)

Measurements carried out on phantoms have shown that the amount of radiation received by the skin of the patient during fluoroscopy is subject to considerable variation. In addition to the predictable factors such as kv, current, wave form, filtration, and tube-skin distance there are several other factors which cannot be readily predicted. These include radiation protection of the tube, variations in the width of the field, and absorption by the apparatus. The kv and current indicated by the control panel cannot be absolutely relied on. In one case the amount of radiation delivered varied despite the constant factors employed. Exact measurements of the amount of radiation produced by each new radiographic unit are suggested before the unit is put into use, as well as checks following repairs and routine checks at regular intervals. Estimations using curves or tables are not sufficient. (auth)

30469 RADIATION BURDEN OF BONE MARROW IN X-RAY DIAGNOSTICS. K. Brezina and G. Fuchs (Kaiser-Franz-Josef-Spitals, Vienna). Fortschr. Gebiete Röntgenstrahlen u. Nuklearmed, 95: 98-103(July 1961). (In German)

For determining the marrow dose a chest phantom was constructed and the ionization chamber introduced into the body of the 9th dorsal vertebra. X-ray pictures were taken in various positions and under various conditions and doses measured. While in the p.a. position with 50 kv an average marrow dose of 16 mr was found, dose was increased to 28 mr with supervoltage technique (120 kv). Further measurements were taken with screening, fluorography, and tomography. It is suggested screening be restricted to those cases in which additional information might be expected. (auth)

30470 ESTIMATION OF FAST NEUTRON DOSES IN MAN BY $S^{32}(n,p)P^{32}$ REACTION IN BODY HAIR. D. F. Petersen, V. E. Mitchell, and W. H. Langham (Los Alamos Scientific Lab., N. Mex.). Health Phys., 6: 1-5(Aug. 1961).

The high S content of human hair was utilized to estimate incident fast neutron dose by measuring β activity arising from the $S^{32}(n,p)P^{32}$ reaction. Analysis of a large number of hair samples demonstrated that regardless of variation in color, consistency, and distribution, the chemical composition was remarkably constant. The S content was 47.7 ± 5.5 mg/g, and P content was 0.155 ± 0.042 mg/g of hair. Since the activation cross-sections of S and P are essentially the same, virtually all P^{32} activity present in the hair sample was derived from fast neutron capture by S. Experiments using the well defined fission spectrum of Godiva, an unshielded critical assembly, indicated that total neutron doses could be consistently estimated within ±10% and that the orientation of samples on a plastic mannequin could be deduced by their relative specific activities. The lower limit of sensitivity of the method is approximately 5 rads of neutrons with energies in excess of 2.5 Mev using 1.0 g hair samples. (auth)

30471 RESPONSE OF BURROS TO NEUTRON–γ-RADIATION. Ralph E. Thomas and Daniel G. Brown (UT-AEC Agricultural Research Lab., Oak Ridge, Tenn.). Health Phys., 6: 19-26(Aug. 1961).

The response of burros to neutron–γ-radiation was studied. Seven animals received 180 rads (145 rads n, 35 rads γ) at a rate of 6 rads per min. The death of two burros at this dose level was unexpected. The clinical symptoms of these animals resembled those of central nervous system damage, heretofore seen with larger doses and much higher dose rates. The five survivors exhibited symptoms of neurological derangement but to a much lesser degree. The

interval between exposure and maximum depression of leukocytes was 1 week, a shorter period than has been recorded in other burro studies. The initial rise in number of neutrophils and the depression of lymphocytes followed previously observed patterns. Epilation began as expected; however, the delayed epilation reported is without recorded precedence in this species. There is an indication of a weight-response relationship to neutron–γ-irradiation in the burro. A comparison of the hematological response of man and burros to similar amounts of neutron–γ-radiation is presented. (auth)

30472 CHANGES IN PLASMA AMINO ACIDS DURING DEVELOPMENT OF X-IRRADIATED CHICK EMBRYOS. Elaine Katz Bernstein (Argonne National Lab., Ill.). Intern. J. Radiation Biol., 3: 449-57(Sept. 1961). (In English)

Studies were made of the plasma amino acids of chick embryos from days 5–19 of development after x irradiation with 600 r on the fourth day of incubation. The levels of amino acids in the 6–8 day embryos decreased: this was a general effect and was not specific for any single amino acid. The levels of amino acids in the 5 day and in the 9–19 day embryos increased: this, again, was a general effect and was not specific for any single amino acid. For days 9–12 the increase in free amino acids was statistically significant. No abnormally occurring amino acids were present. It is believed that the responses of the embryos between 5 and 8 days may be peculiar to developing embryonate tissue, while the responses between 9 and 19 days indicate a basic metabolic disturbance and not one that is peculiar to embryonate tissue. Possible relationships between this increase in free plasma amino acids following x irradiation and the enhancement of the growth of rickettsial organisms by administration of x irradiation are discussed. (auth)

30473 BIOCHEMICAL STUDIES ON MICE 6–18 MONTHS AFTER TOTAL-BODY X-IRRADIATION. M. P. Esnouf, Margery G. Ord, and L. A. Stocken (Oxford Univ.). Intern. J. Radiation Biol., 3: 459-66(Sept. 1961). (In English)

Male CBA mice 6–10 months after exposure to LD_{20-30} (30 days) x radiation were examined. The weights of body, testes, heart, and kidney were reduced. There was no change in fat or water content of the organs, nor was the total water content of the carcass affected. The total fat content of the carcass increased in irradiated mice. There was a reduction in the incorporation of P^{32} into kidney-DNA relative to that into RNA. (auth)

30474 FURTHER BIOCHEMICAL STUDIES ON MALE AND FEMALE MICE SOME MONTHS AFTER TOTAL-BODY X-IRRADIATION. T. J. Franklin (Oxford Univ.). Intern. J. Radiation Biol., 3: 467-73(Sept. 1961). (In English)

High doses of whole-body x irradiation produced a decrease in the fat content of the skin of female CBA mice examined some months after the exposure. The weights of the heart and kidneys were not different from the unexposed controls. The irradiation brought about a permanent depression in DNA-synthesis relative to RNA in the kidneys of both sexes. (auth)

30475 LIFE-SHORTENING IN FEMALE CBA MICE EXPOSED TO DAILY IRRADIATION FOR LIMITED PERIODS OF TIME. R. H. Mole and A. M. Thomas (Medical Research Council Radiobiological Research Unit, Harwell, Berks, Eng.). Intern. J. Radiation Biol., 3: 493-508(Sept. 1961). (In English)

Female CBA mice were exposed to daily irradiation by gamma rays or fast neutrons at daily doses of from 3–50 rems for periods varying from four weeks to the duration of life. At daily doses between 3 and 30 rems, the mean survival-time reached a near minimum value after an exposure lasting less than half the duration-of-life exposure. Additional exposure had little further effect on survival-time. The shape of the mortality curve depended systematically on the particular level of daily dose and on the duration of exposure, except possibly at the lowest daily dose. It is concluded that, if experimental support is to be sought for hypotheses relating life-span simply to dose or dose rate, then experiments must be done with total doses of not more than a few hundred rems or with daily doses smaller than 3 rems. The shape of the curve relating total dose to mean survival time in duration-of-life exposures can be accounted for on the assumption that all radiation damage is, in a mathematical sense, reparable. There is a fallacy in arguing that the shape of the curve necessitates the assumption that some radiation damage is irreparable. On the other hand, when the biological character of the damage is taken into account in experiments in which a near 100% incident of malignant disease followed a limited period of continued irradiation, it must be considered that almost the whole of delayed radiation damage may be irreparable, even with gamma rays. The rbe for life-shortening by daily irradiation with fast neutrons was found to be independent of exposure time, but may perhaps vary with dose rate, possibly because the biological processes mainly responsible for life-shortening differ at different dose rates. (auth)

30476 CONTRIBUTIONS TO THE STUDY OF IMMEDIATE AND EARLY X-RAY REACTIONS WITH REGARD TO CHEMOPROTECTION. III. THE FILTRATION OF WATER AND OF RED CELLS THROUGH THIN CONNECTIVE-TISSUE CORIUM MEMBRANES UNDER LOW-LEVEL X-IRRADIATION. R. Brinkman, H. B. Lamberts, and J. Zuideveld (Univ. of Groningen, Netherlands). Intern. J. Radiation Biol., 3: 509-13(Sept. 1961). (In English)

It is shown that the water-permeability of isolated connective-tissue membranes is very sensitive to the combination of weak mechanical tension and x irradiation. The analogy with the effects of irradiation, dithionite, and chemoprotectors on synovial viscosity is very clear. (auth)

30477 THE STUNTING OF GROWTH IN YOUNG RABBITS INJECTED WITH STRONTIUM 90. Sheila MacPherson (Churchill Hospital, Oxford). Intern. J. Radiation Biol., 3: 515-23(Sept. 1961). (In English)

The effect of an injection of Sr^{90} on the growth of young rabbits was studied. Two levels of injection were used, 100 μc of Sr^{90} per kilogram of body-weight, and 600 μc/kg. The animals were killed at various time intervals after injection, up to 180 days later. Measurements were made on the terminal body-weight, weight of the femur and tibia, and length of the tibia, both for injected animals and controls. All the four measurements on the animals which received 600 μc/kg showed significant stunting of growth, while the animals injected with 100 μc/kg were not significantly different from the controls. The growth of the proximal epiphyseal cartilage plate of the tibia, during the first few weeks after injection, was also measured radiographically: the animals with 600 μc/kg again showed significant stunting of growth. Some observations of the radiation dosimetry and pathology of the animals are discussed briefly. (auth)

30478 A COMPARISON OF THE RESPONSE TO INJECTED RADIOACTIVE PHOSPHORUS AND TO X-RAYS IN THE HAEMATOPOIETIC TISSUE OF RATS. N. M. Blackett (Royal Cancer Hospital, London). Intern J. Radiation Biol., 3: 525-37(Sept. 1961). (In English)

The radiation response of hematopoietic tissue in rats

following the administration of P^{32} is compared with the response to acute whole-body x irradiation in terms of the radiation dose to different tissues, using thick-section autoradiography for measuring the radiation dose to the bone marrow in the animals treated with P^{32}. Changes in the peripheral blood picture and results of Fe^{59} tracer studies in splenectomized and intact rats are presented. In spite of considerable differences in the conditions of irradiation, a number of similarities in the response of hematopoietic tissue are obtained with these two methods of irradiation. It is suggested that there is little or no dose rate effect over the range ~30 r/min to ~0.2 rads/min for this tissue. A considerably earlier recovery of erythropoiesis in the spleen after P^{32} than after x irradiation is demonstrated. (auth)

30479 THE SURVIVAL OF GERM CELLS AFTER IRRADIATION OF THE NEONATAL MALE RAT. L. K. Harding (The University, Birmingham, Eng.). Intern. J. Radiation Biol., 3: 539-51(Sept. 1961).

Seventy male rats aged four to eight days were exposed to 0–430 r of x radiation. Counts were made at 12, 24, and 72 hours after irradiation of normal and degenerating germ cells at different developmental stages and of supporting cells. The decrease in the number of gonocytes which normally occurs with advancing age was partially inhibited by irradiation. The number of gonocytes undergoing lysis increased after treatment. No reduction in the number of type-A spermatogonia was detected until 72 hours after irradiation. In contrast, intermediate-type and type-B spermatogonia, as well as primary spermatocytes, became markedly depleted at 72 hours. The numbers of normal supporting cells decreased sharply after irradiation. Cells undergoing degeneration were consistently more numerous in irradiated than in control animals. While the radiosensitivity of intermediate-type and type-B spermatogonia is of the same order in neonatal and adult rats, type-A spermatogonia are slightly more radio-sensitive in the adult. Irradiation of the testis of the neonatal rat appears to cause inhibition of mitosis as well as cell-death. (auth)

30480 THE SPECIFICITY OF MANIFESTATION OF OXYGEN EFFECT UNDER THE ACTION OF α-RAYS. E. S. Shchepoteva, S. N. Ardashnikov, G. E. Lur'e, and T. B. Rakhmanova (Inst. of Health Resorts and Physical Therapy, Moscow). Izvest. Akad. Nauk S.S.S.R., Ser. Biol., No. 4, 642-9(July-Aug. 1961). (In Russian)

No oxygen effect was found upon irradiation of a variety of plants and animals (roots and seeds of Vicia faba, spawn and tadpoles of frogs, adult frogs, mice) with solutions of radon and air-thoron mixture. The results are interpreted from the point of view of linear density of ionization in the distribution of radicals and from the point of view of kinetics of radiation-chemical reactions as determined by this distribution. Conditions are created during α-irradiation conducive to the formation of molecular oxygen in the medium irradiated. (auth)

30481 EFFECTS OF X RAYS ON THE REPRODUCTIVE PERIOD OF YOUNG RATS AND THE PROTECTIVE ROLE OF CYSTEAMINE. D. M. Pavic, N. S. Mirkovic, and D. S. Sladic-Simic (Institut des Sciences Nucleaires, "Boris Kidric," Belgrade). J. belge radiol., 44: 321-32(1961). (In French)

A study was made of post-radiation sterility and the effects of x-rays on the ovaries of adult, and at the time of irradiation from 8- to 17-day old female rats; the possible protection by cysteamine was also studied. The whole body was exposed to an irradiation of 200 r. It was observed that a dose of 200 r had not the same effect on the ovaries of animals of different ages at the moment of irradiation. Adult animals still remain fertile during a certain time whereas young animals are completely sterile from the onset. Cysteamine as a protective agent has no effect on post-irradiation sterility in 8-day old female rats; in 17-day old animals it confers a temporary protection of 50%. In adult female rats the reproduction period is prolonged. (auth)

30482 CIRCUMSCRIBING IRRADIATION OF SURFACE STRUCTURES OF CYLINDRICAL ANIMAL AND PLANT CELLS WITH POLONIUM-210 α-PARTICLES. R. M. Bergström, R. F. Blåfield, and M. W. Brenner (Univ. of Helsinki). Nature, 191: 1165-6(Sept. 16, 1961).

A method which makes use of a cylindrical polonium-210 α source is described. The polonium-210 is deposited on the cylindrical inner surface of a silver ring. The nerve or plant cell is held in the center of the ring, along the axis of the active cylindrical area. By counting the density of tracks along the cylindrical axis, the intensity of the α radiation and the activity of the source were determined. One application of the method, some ultrastructural changes of the internodal cells of the alga Nitella flexilis, is briefly described. (P.C.H.)

30483 THE QUESTION OF THE ACCUMULATION OF THE CANCEROGENETIC RADIATION EFFECT IN FRACTIONATED X-RAY WHOLE-BODY IRRADIATION OF WHITE RATS. E. Stutz, W. Huntstein, and U. Reincke (Universitätsklinik, Freiburg i. B.). Naturwissenschaften, 48: 505(1961). (In German)

The accumulation of fractionated radiation doses, in analogy to the accumulation effect of cancerogenic substances, was investigated on two groups of Wistar rats each receiving a total whole body dose of 900 r. The first group received the total dosage in exposures of 10 r six times a week. The second group received three 300-r irradiations. The life span of the first group was 24.5 months compared with 19.5 months for the second group. The tumor incidence of both groups is approximately equal. The cancerogenic effect of the radiation depended completely on the total dose and not on the degree of fractionation. The results showed that an accumulation of the cancer-producing radiation damage occurs. (J.S.R.)

30484 SOMATIC EFFECTS AND DAMAGE FROM IONIZING RADIATION. H. Grössinger. Neue Physik, 2: 104-17(1960). (In German)

A brief survey is made from the medical viewpoint on the somatic effects and damage from ionizing radiation. (tr-auth)

30485 THE EFFECTS OF RADIOACTIVE RADIATION ON PLANTS. S. G. Tedoradze (Georgian Experimental-Selectivity Lab., Mtskheta Natakhtari). Priroda, 50: No. 4, 104-5(Apr. 1961). (In Russian)

Experiments with three types of soybeans irradiated with 7000 and 12000 r show that 12000 r is either lethal or detrimental to growth while 7000 r is favorable to normal plant developed, some plants showing certain tendencies to variations in shape, color, appearance, ripening time, and yield. Experiments with beans irradiated with 5000, 7000, 8000, 10000, 12000, 16000, 20000, 25000, and 30000 r (at 600 r per minute) showed that doses over 16000 r slow growth and development, and doses over 20000 r are lethal. Doses from 5000 to 12000 r result in normal development with some progressive growth. Certain plants ripened 8 to 10 days ahead of control plants while others ripened 10 to 25 days later with 20 to 31% higher yields. It was found that 12000 r and over is lethal for soybean while 16000 r and over is lethal for the bean. (R.V.J.)

30486 HUMORAL REGULATION OF ERYTHROPOIESIS. VI. MECHANISM OF ACTION OF ERYTHROPOIETINE IN THE IRRADIATED ANIMAL. Frederick Stohlman, Jr. (National Inst. of Arthritis and Metabolic Diseases, Bethesda, Md.). Proc. Soc. Exptl. Biol. Med., 107: 751-4(Aug.-Sept. 1961).

Erythropoietine produces an increase in reticulocytes in transfused animals within 48-72 hours. In irradiated animals the response is delayed, length of delay being in part dose dependent. A change in reticulocytes is not observed until 96 hours when erythropoietine is given immediately after 200 r; after 400 r the effect is first noted at 6 days. A tentative hypothesis is proposed to explain these results. It is suggested that erythropoietine promotes differentiation of stem cells into erythroid elements and that depopulation of the stem cell compartment stimulates division within that compartment. (auth)

30487 SUPPRESSION OF THE FOREIGN BONE MARROW REACTION BY PREIRRADIATION OF DONOR MICE. Gustavo Cudkowicz (Oak Ridge National Lab., Tenn.). Proc. Soc. Exptl. Biol. Med., 107: 821-4(Aug.-Sept. 1961).

Preirradiation of donor mice with 400-500 r of x rays resulted in a marked reduction of secondary disease in homologous radiation bone marrow chimeras. The results are tentatively attributed to elimination of immunologically competent cells from donor marrow by x radiation to an extent adequate to inhibit the development of clinically significant graft-versus-host immune reactions. This effect was not detectably inhibited by administration of a radioprotective compound (AET) 20-30 minutes before irradiation of donor mice, implying that AET did not protect immunologically competent cells to the same extent as hemopoietic cells against radiation injury. (auth)

30488 CYTOCHROME OXIDASE IN RADIOSENSITIVE AND RADIORESISTANT AMOEBAE. John F. Thomson and Edward W. Daniels (Argonne National Lab., Ill.). Proc. Soc. Exptl. Biol. Med., 107: 916-19(Aug.-Sept. 1961).

Cytochrome c oxidase activity was demonstrated in 2 species of the giant amoeba Pelomyxa, one of which is radioresistant and the other radiosensitive. The differences observed in this enzyme do not appear to be sufficient to account for the 10-fold difference in radiosensitivity of the living organisms. The level of cytochrome c oxidase activity is about one-fortieth that of mammalian liver, and is highly labile at room temperature. The radioresistant Amoeba proteus was also assayed for cytochrome c oxidase activity but almost negligible amounts were found. (auth)

30489 RELATION OF MAMMOTROPES TO MAMMARY TUMORS. V. ROLE OF MAMMOTROPES IN RADIATION CARCINOGENESIS. Kenjiro Yokoro and Jacob Furth (Roswell Park Memorial Inst., Buffalo). Proc. Soc. Exptl. Biol. Med., 107: 921-4(Aug.-Sept. 1961).

X rays (50r) and mammotropic hormones (administered in the form of isologous functional mammotropic pituitary tumor grafts) alone produced no mammary tumors in female W/Fu rats within 7 months of treatment. In contrast, 53% of the rats treated with both, developed mammary tumors. As with chemical carcinogen-induced tumors, administration of mammotropic hormones restored inhibition of mammary tumor development by ovariectomy. Most mammary tumors induced by radiation plus mammotropic hormones were adenocarcinomas; a few were fibroadenomas. Three induced tumors tested were found to be highly mammotropic hormone responsive: they did not grow in males and grew in females uniformly only when stimulated with mammotropic hormones. Grafted fibroadenoma cells remained latent in many rats until administered mammotropic hormones brought about their rapid growth. Administration of this hormone could be delayed as long as 7½ months. It is concluded that radiations bring about an irreversible modification of some cells, depending on severity of the dose; mammotropic hormones are not carcinogens but, as promoters of mammary epithelium, promote carcinogenesis and growth of some tumors. (auth)

30490 THE TIME-INTENSITY FACTOR IN DRY SEED IRRADIATION. A. T. Natarajan and M. M. Maric (Brookhaven National Lab., Upton, N. Y.). Radiation Botany, 1: No. 1, 1-9(Sept. 1961). (BNL-5241)

Using dry barley seeds and heterozygous maize seeds, it was demonstrated that there is a time-intensity effect on biological response to electromagnetic radiations, such as x and gamma rays. Lower intensity was found to be more effective than high intensity. This response is in contradiction to results from other organisms studied previously, where the response was either dose rate independent or the higher intensity was more effective than lower intensity. This time-intensity factor does not operate in wet seeds (10% and greater moisture content) to any appreciable degree. The time-intensity factor in dry seeds was shown to be an expression of storage effect accumulated during the period of irradiation and thus dependent on the moisture content and the dose rate. Hence, the factors responsible for storage effect seem to be responsible for this time-intensity effect. It is suggested that in critical radiation studies with dry seeds, in addition to factors such as moisture content, storage time, and method of hydration, consideration should also be given to both the exposure time and the intensity of the radiation. (auth)

30491 SOME FACTORS AFFECTING THE RESPONSES OF PLANTS TO ACUTE AND CHRONIC RADIATION EXPOSURES. A. H. Sparrow, R. L. Cuany, J. P. Miksche, and L. A. Schairer (Brookhaven National Lab., Upton, N. Y.). Radiation Botany, 1: No. 1, 10-34(Sept. 1961). (BNL-4912)

The radiobiological responses of a large number of species of higher plants were studied after acute or chronic irradiation of growing plants with gamma or x radiation. The radiation responses studied were of four main types: chromosome breakage, somatic mutation, growth inhibition, and lethality. The yield of somatic mutations is reduced by dose fractionation of acute exposures or, within limits, by reduced dose rates with chronic exposures. A correlation was shown between the acute and daily chronic doses necessary to produce severe growth inhibition in young plants of several different species. In diploid species a clear relationship was shown between the average nuclear volume of apical meristem cells and tolerance to chronic gamma radiation. Some theoretical aspects relating to the interrelationship of certain major factors determining radiosensitivity are presented. These studies led to some new concepts of the role of cytogenetic damage in radiobiological responses. In particular, the roles of nuclear volume and chromosome number in determining radiosensitivity are considered in some detail. (P.C.H.)

30492 CYTOLOGICAL EFFECTS OF PHENYLNITROSAMINES. III. THE EFFECT ON X-RAY SENSITIVITY AT LOW OXYGEN TENSIONS. B. A. Kihlman (Univ. of Uppsala). Radiation Botany, 1: No. 1, 51-60(Sept. 1961).

A number of agents structurally or functionally related to cupferron were studied for their ability to enhance the frequency of chromosomal aberrations produced by x rays in the presence of 1% oxygen in the root-tips of Vicia faba. A marked enhancement was obtained only with agents which

inhibited bean-root respiration. In experiments with the respiratory inhibitor carbon monoxide, the x ray dose necessary to produce a given frequency of aberrations in the absence of oxygen was about 2.3 times as high as that which produced the same effect in the presence of 1% oxygen. The carbon monoxide effect was light-reversible; no enhancement was obtained when the roots were exposed to strong light during irradiation and carbon monoxide treatment. Both cupferron and carbon monoxide enhanced x ray sensitivity only when they were present before and during irradiation. Post-treatments with these agents did not have any influence on the frequency of aberrations produced by a given x ray dose. The frequency of aberrations produced by 108 r of x rays was almost doubled when the change from 1% oxygen in nitrogen to 1% oxygen in carbon monoxide was made 70 sec before irradiation. In order to be fully effective, the CO-treatment was started between 2 and 5 min before irradiation. These results support the hypothesis that cupferron and other respiratory inhibitors enhance the x ray sensitivity of bean roots at low oxygen tensions because they prevent the formation of an oxygen gradient in the roots. A comparison between the cytological and physiological effects of cupferron, and those of some other agents which are structurally or functionally related to it, is presented in tabular form. (auth)

30493 RADIATION SENSITIVITY STUDIES ON RELATED FERMENTING AND RESPIRING YEASTS. R. T. O'Brien (General Electric Co., Richland, Wash.). Radiation Botany, 1: No. 1, 61-8(Sept. 1961). (HW-SA-2076)

Respiration deficient or fermenting yeasts were shown to be more sensitive to x-ray inactivation than genetically related respiring cells. Four fermenting isolates were studied, one of which was intermediate in sensitivity between the remaining fermenting cultures and respiring cells. The difference in radiation sensitivity observed with these yeasts could not be accounted for by such factors as age of the cells, bud frequency, cytochrome content, or respiration deficiency. However, significant differences were noted in catalase content. The correlation between catalase activity, peroxide sensitivity, and radiation sensitivity indicated that a deficiency in catalase was responsible for the increased sensitivities of the fermenting yeasts. A mechanism for catalase protection from radiation is discussed. (auth)

30494 THE GENERAL MORPHOLOGY AND GROWTH RESPONSES OF TWO SPECIES OF NICOTIANA AND THEIR INTERSPECIFIC HYBRID AFTER CHRONIC GAMMA IRRADIATION. N. Meiselman, J. E. Gunckel, and A. H. Sparrow (Brookhaven National Lab., Upton, N. Y. and Rutgers Univ., New Brunswick, N. J.). Radiation Botany, 1: No. 1, 69-79(Sept. 1961). (BNL-5255)

Specific responses to chronic irradiation with daily doses up to 375 r/day are described for plants of Nicotiana bigelovii (2n = 24), N. glauca (2n = 48), and N. bigelovii × N. glauca (2n = 36). Induced irregularities in the growth of stems, leaves, and buds are described and correlated with the histological appearances. The three stocks differ in degree of radiosensitivity and each has a characteristic set of responses. Sensitivity seems to be related to chromosome number since stem and leaf responses were apparent in N. bigelovii at 300 r/day after one month of exposure, in the hybrid at 150 r/day, and in N. glauca at 75 r/day. The growth habit of all three stocks changed after 300–375 r/day for one month, but the hybrid was most affected. Histological sections of shoot apices and of axillary buds showed that loss of polarity and organization so evident in the hybrid results from the formation of enations, intumescences or tumors, and aberrant short shoots from multiple, adventitious growth centers. Induced chromosomal abnormalities and induced physiological changes are discussed as possible causal agents of the radiation responses. (auth)

30495 THE EFFECT OF AGE OF SEED ON THE FREQUENCY OF SPONTANEOUS AND GAMMA RAY INDUCED CHROMOSOME ABERRATIONS. K. Sax and H. J. Sax (North Carolina State Coll., Raleigh). Radiation Botany, 1: No. 1, 80-3(Sept. 1961).

The aging of onion seeds for one year more than doubled the frequency of spontaneous chromosome aberrations in the first divisions of the root tip cells. The older seeds also showed about 50% greater sensitivity to gamma radiation as measured by the increased frequency of induced chromosome aberrations. (auth)

30496 THE EFFECT OF RADIATION ON CHIASMA FORMATION IN TRADESCANTIA. C. W. Lawrence (Wantage Research Lab., Berks, Eng.). Radiation Botany, 1: No. 1, 92-6(Sept. 1961).

The effect of irradiation of different premeiotic and early meiotic stages on chiasma frequency was investigated in Tradescantia paludosa. An increase in chiasma frequency was found following irradiation with 30 rad of late zygotene-early pachytene, and it is probable that a slight decrease resulted from the irradiation of late preleptotene. In these respects the results follow closely those previously obtained with Lilium. They differ, however, by the absence of any response to the irradiation of late diplotene. This is probably related to the absence of any loss of chiasmata between diplotene and metaphase in Tradescantia. The results from Tradescantia also differ from those using Lilium in the apparent duration of the later radiosensitive period. In Tradescantia there is apparently a continuous and increasing response to irradiation throughout zygotene, but it is argued that this is due to variations in the developmental rates of the plants, and that in fact the sensitive period in Tradescantia, as in Lilium, is restricted to the late zygotene-early pachytene stage. (auth)

30497 DOES A COFFEE PLANT DEVELOP FROM ONE INITIAL CELL IN THE SHOOT APEX OF AN EMBRYO? C. C. Moh (Inter-American Inst. of Agricultural Sciences, Turrialba, Costa Rica). Radiation Botany, 1: No. 1, 97-9(Sept. 1961).

Evidence obtained from R_1 morphological mutants suggests that except for the epidermis, development of a young coffee shoot is from a single initial cell of the corpus. This conclusion is supported by the high frequency of R_1 non-chimeric mutants, shapes of the dosage response curves with x rays and neutrons and the association of pollen sterility with some of the mutants. (auth)

30498 RADIOBIOLOGY. Proceedings of the Third Australasian Conference on Radiobiology Held at the University, Sydney, 15-18 August, 1960 by The Australian Radiation Society. P. L. T. Ilbery, ed. London, Butterworths, 1961. 323p. $11.00.

Twenty-nine papers are included. Separate abstracts have been prepared for 27. Two papers were previously abstracted in NSA. (C.H.)

30499 THE NATURE OF RADIATION DAMAGE AT THE SUBCELLULAR LEVEL. Peter Alexander (Royal Cancer Hospital, London). p.1-16 of "Radiobiology." London, Butterworths, 1961.

Reaction mechanisms are reviewed that are involved in radiochemical reactions that initiate the complex process which eventually leads to cell injury and death. Topics

discussed include the physiological effects of radiation, interphase and mitotic death of cells, variations in radiosensitivity and intracellular protection, the relative importance of direct and indirect radiation effects, the role of desoxyribonucleic acid in the production of primary lesions, the biological effects of alpha particles, radiation damage to membranes and intracellular barriers, and the mechanism by which oxygen enhances the radiation lesions of sparsely ionizing radiations. 34 references. (C.H.)

30500 EFFECTS OF GAMMA RADIATION ON RIBONUCLEASE. Sidney Rubenfeld and Evelyn Slobodian (New York Univ., New York). p.17-26 of "Radiobiology." London, Butterworths, 1961.

A comparative evaluation of the effects of γ irradiation and OH radicals on solutions of ribonuclease led to the conclusion that OH radicals may be the principal intermediates in the radiation effect at the cellular level. Evidence is presented for a difference in reactivity between the ribonuclease A molecule and the B fraction. It is suggested there may be significant differences in the structural features related to the enzymatic function. (C.H.)

30501 CHROMOSOME DAMAGE PRODUCED BY RADIATIONS. John Read (Wakari Public Hospital, Dunedin, N. Z.). p.27-36 of "Radiobology." London, Butterworths, 1961.

The hypothesis that chromosome damage is the important lethal effect of ionizing radiations is examined. Results are reported from a series of studies on the effect of x rays, α particles, 8-ethoxycaffein, nitrogen mustard, and triethylene melamine on chromosomes in the roots of Vicia faba under both aerobic and anaerobic conditions. It is suggested that changes in growth rate are a result of cell death caused by chromosome damage which did not manifest itself until the cell reached the next division. A direct relation is suggested between growth reduction and chromosome damage. Results are also reported for studies of photodynamic breakage of chromosomes with the aid of acridine orange dye. The importance of the composition of chromosomes in radiation biology is discussed. Procedures are described for measuring Feulgen-stained metaphase chromosomes on microphotographs, and methods for determining the size, structure, and composition of chromosomes are discussed. Reaction mechanisms associated with the target theory of chromosome breakage by radiations are reviewed. (C.H.)

30502 CYTOGENETIC ANALYSIS OF CELL POPULATIONS IN RADIATION CHIMAERAS. C. E. Ford (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.39-45 of "Radiobiology." London, Butterworths, 1961.

Results are reported from a cytogenetic analysis of cell populations in irradiated mice injected with bone marrow cells from the same inbred mouse strain, a different inbred mouse strain, or rats. The origin of regenerated hematopoietic tissue and the fate of the graft were investigated by a chromosome marker method. Results are presented for 4 separate series of chimeras. (C.H.)

30503 HAEMOPOIETIC HOMOGRAFTS RETRANSPLANTED THROUGH RADIATION CHIMAERAS. C. E. Ford, P. L. T. Ilbery, and S. M. Winn (Univ. of Sydney). p.46-53 of "Radiobiology." London, Butterworths, 1961.

Results are reported from experiments in which bone marrow from 6-months-old mouse radiation chimeras was transplanted into irradiated animals of both host and donor strains, and after an interval of 3 to 6 months, into further irradiated mice of the same strains. The persistence of the phenomenon of adaptation was investigated by means of exteriorized lymph nodes and cells labeled with marker chromosomes. Results indicate that the property of adaptation by donor cells to the primary host's antigens is retained on transmission to secondary hosts. (C.H.)

30504 EXPERIMENTS IN SKIN HOMOGRAFT SURVIVAL. Maxwell Kent (Univ. of Melbourne). p.54-8 of "Radiobiology." London, Butterworths, 1961.

Results are reported from a study of the survival of skin autografts and homografts in 400 rabbits. The effects of whole-body irradiation, antibiotic therapy, and bone marrow infusions on the survival of the grafts were studied. Data are presented graphically and results are discussed. (C.H.)

30505 PRESERVATION OF VIABLE BONE MARROW BY FREEZING. Phan The Tran and M. A. Bender (Atomic Energy Office, Saigon, Viet Nam and Oak Ridge National Lab., Tenn.). p.59-64 of "Radiobiology." London, Butterworths, 1961.

Results are reported from a study of the effect of glycerol concentration, rate of freezing, rate of thawing, refreezing, storage temperature, storage time, polyalcohols, mono- and disaccharides, amino acids, and inorganic salts on the survival of frozen bone marrow preparations. The 30-day survival of lethally irradiated mice given frozen and thawed marrow cells was used as an assay of the viability of the cells. By selecting the proper radiation dose and controlling the number of cells injected, it was possible to obtain quantitative results. It was concluded that there are available a number of excellent protective compounds for practical bone marrow preservation by freezing. Of these, glycerol gave the best results. (C.H.)

30506 EFFECT OF RADIATION AND TISSUE TRANSFER ON THE IMMUNE RESPONSE. P. C. Koller, S. M. A. Doak, and A. J. S. Davies (Royal Cancer Hospital, London). p.65-83 of "Radiobiology." London, Butterworths, 1961.

Results are described from experiments designed to study the effect of tissue transfers on the immune response in animals exposed to various doses of radiation. Data are tabulated from studies on immune responses after sublethal irradiation and tissue transfer in mice, immune responses after lethal irradiation and tissue transfer, response in isologous chimeras, adult bone marrow therapy, fetal tissue therapy, skin homografts, response in homologous chimeras, late responses, homograft acceptance and rejection, and reactions involved in the transfer of marrow from chimeras. (C.H.)

30507 COMPONENTS OF RADIATION CARCINOGENESIS. Jacob Furth and Kenjiro Yokoro (Roswell Park Memorial Inst., Buffalo and Univ. of Buffalo). p.86-97 of "Radiobiology." London, Butterworths, 1961.

A survey of facts on radiation carcinogenesis points to heterogeneity of events. Two types of factors are involved, one bringing about an apparently irreversible modification of the irradiated cell and the other promoting and restraining forces which alone are not primarily carcinogenic. Neoplasia can be scopal, with the tumor arising in an irradiated cell as a consequence of seemingly permanently irreversible modification, or the neoplasia can be abscopal, arising in an unirradiated cell as a consequence of permanent modification of one of its regulator cells causing a derangement of its homeostat. Radiation can cause three types of permanent alterations in cells. These include changes in appearance and function, changes in responsiveness to forces regulating the cell numbers and yielding a fully autonomous tumor, and changes in responsiveness to the physiological

regulators resulting in a hormone responsive tumor. The cells altered permanently by radiation can remain latent until a stimulant is applied. The initial modification appears irreversible, is lasting, and can be conceived as a mutation, but other types of lasting alterations are also feasible. The role of viruses in carcinogenesis has not been adequately studied, but it is suggested that radiation can activate a latent virus. Parasitic nucleic acids may interfere with the cell's homeostatic control and thus may cause a virus conditioned neoplasm. It is considered unlikely that all radiation-induced neoplasms are related to viruses, and that, while the generalized virus theory of radiation neoplasms is purely conjectural, the chromosomal abnormalities strongly suggestive of mutations are realities, as are the environmental influences, including hormones, which determine whether or not a radiation-induced neoplastic change will eventuate in a tumor. (C.H.)

30508 APPLICATION OF THE TWO-STAGE MECHANISM OF CARCINOGENESIS TO LEUKAEMOGENESIS WITH LOW DOSES OF X-RAYS AS INITIATING FACTOR. I. Berenblum and N. Trainin (Weizmann Inst. of Science, Rehovoth, Israel). p.98-101 of "Radiobiology." London, Butterworths, 1961.

Preliminary results are reported from studies on the two-stage mechanism for carcinogenesis. X radiation was administered to mice in 5 doses of 90 r each at 5-day intervals. Urethane was administered in 5 intraperitoneal injections, at 5-day intervals, of 0.2 ml of a 10% solution in distilled water, totalling 100 mg. Urethane administered at the same time as x radiation caused a marked increase in leukemogenesis, while urethane alone was completely inactive. When urethane was given 2 weeks after completion of the x-ray treatment, leukemogenesis was augmented, but when urethane was given 2 weeks after commencement of the x-ray treatment, it was not augmented. Urethane appeared to act as a pure promoting agent for leukemogenesis. Possible implications of a two-stage mechanism in leukemogenesis are discussed. (C.H.)

30509 RADIATION IN THE AETIOLOGY OF SPORADIC HUMAN LEUKAEMIA. F. W. Gunz (Christchurch Hospital, N. Z.). p.102-13 of "Radiobiology." London, Butterworths, 1961.

Findings are presented from a 2-year survey on the relation of radiation exposure to leukemia incidence in the population of New Zealand. Among the leukemic cases reported, 21 or 7% had received therapeutic x irradiation at some time before the onset of the disease. While there was clearly a significant accumulation of therapeutically irradiated individuals in the leukemic group it was not possible to attribute the disease to the radiation exposure. (C.H.)

30510 MECHANISMS OF RADIATION PROTECTION BY CYSTEAMINE. Peter Alexander (Royal Cancer Hospital, London). p.129-37 of "Radiobiology." London, Butterworths, 1961.

The term chemical protection is confined to those situations where the administration of a chemical before irradiation reduces the biological effect of a subsequent exposure to radiation. Radiation damage to a given molecule can be prevented by diverting the absorbed energy, by repairing the damaged molecule, or by combination of the protective agent with the target molecule thereby rendering it more radioresistant. Cysteamine has been found effective for protecting animals against radiation injury by all of these mechanisms. Results are reported from recent studies in model systems with cysteamine. (C.H.)

30511 COMPARATIVE EVALUATION OF RADIOPROTECTIVE EFFICACY OF CYSTEAMINE AGAINST 500 r WHOLE BODY IRRADIATION WITH DIFFERENT BIOLOGICAL REFERENCE SYSTEMS. P. De, R. Chatterjee, A. Bose, and S. Bose (Chittaranjan National Cancer Research Centre, Calcutta). p.138-41 of "Radiobiology." London, Butterworths, 1961.

Results are tabulated from a comparative assay of the late radioprotective effectiveness of cysteamine at the cellular level. The mitotic index of bone marrow cells and glycogen metabolism of liver cells in rats were used as a criteria of radiation injury at intervals of 1 to 13 days following exposure to 500 r of whole-body x radiation. (C.H.)

30512 RADIOPROTECTIVE EFFECT OF CHLORPROMAZINE IN VIVO IN RELATION TO TISSUE ANOXIA. Dana Jamieson and H. A. S. van den Brenk (Cancer Inst. Board, Melbourne). p.142-57 of "Radiobiology." London, Butterworths, 1961.

Chlorpromazine, identified chemically as 3-chloro-10-(3-dimethylaminopropyl) phenothiazine hydrochloride, afforded weak protection against the effects of lethal doses of whole-body x irradiation in rats. The protective effects appeared to be closely related to pharmacological properties causing tissue anoxia. (C.H.)

30513 ELECTRON MICROSCOPIC STUDIES OF A TRANSPLANTABLE, RADIATION-INDUCED MOUSE LEUKAEMIA. H. Hoffman and N. Darveniza (Univ. of Sydney). p.161-9 of "Radiobiology." London, Butterworths, 1961.

Particles resembling viruses were observed by means of the electron microscope in the cells of leukemic tissues from C57 and random mice, as well as tissues from a radioinduced leukemic C57 donor. Two different types of particles resembling viruses occurred in the cells of the C57 leukemic animals. (C.H.)

30514 ESTIMATION OF ^{90}Sr BY AN ION-EXCHANGE METHOD. P. S. Davis (Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales, Australia). p.184-90 of "Radiobiology." London, Butterworths, 1961.

A procedure is described for determining Sr^{90} in biological samples following separation on an ion exchange column using Zeo-karb 225 with 12% disodium divinylbenzene copolymer added. Results obtained by nitric acid and ion exchange methods are compared. The ion exchange method was found to be well suited to the routine processing of a large number of samples. (C.H.)

30515 DELAYED EFFECTS OF RADIATION ON SEEDS. Howard J. Curtis (Brookhaven National Lab., Upton, N. Y.). p.193-202 of "Radiobiology." London, Butterworths, 1961.

Cell growth followed by cell division can be initiated at any time in seeds, and radiobiological damage can be measured readily by measuring the height of 7-day seedlings, by estimating cytological damage, or by scoring specific mutations. Results are reported from a series of experiments on the delayed effects of x radiation and neutrons in barley seed. The influence of such variables as oxygen concentration, moisture content, storage time and temperature, and factors affecting mutation rate are discussed. Results indicate that for the production of mutations for crop improvement, neutrons may prove to be the radiation of choice. (C.H.)

30516 RADIATION-INDUCED QUANTITATIVE VARIATION IN SUBTERRANEAN CLOVER. R. D. Brock and

B. D. H. Latter (Commonwealth Scientific and Industrial Research Organization, Canberra). p.205-15 of "Radiobiology." London, Butterworths, 1961.

The variation of x-ray and thermal neutron-induced flowering time was measured in subterranean clover. From the observed increase in variation in the second generation after irradiation, predictions of responses to selection were made and compared with the actual responses achieved in the M_3 generation. The experimental procedures are described. Topics discussed include the increase in variance due to irradiation, response to selection, results of 2-year experiments, and possible applications of the procedure in plant hybridization. (C.H.)

30517 MODIFICATION OF GENETIC RESPONSE TO X-IRRADIATION IN DROSOPHILA. A. M. Clark (Univ. of Tasmania, Hobart). p.216-28 of "Radiobiology." London, Butterworths, 1961.

Results are reported from a series of studies on the effects of radiation dose rate on the genetic response in Drosophila spermatozoa. Data are tabulated on the effect of dose rate on the production of sex-linked lethals and autosomal translocations, the effects of infrared pretreatment on the production of translocations, and the delayed recovery of sex-linked recessive lethals. (C.H.)

30518 INFLUENCE OF ULTRA-VIOLET IRRADIATION ON GENERAL TRANSDUCTION IN PSEUDOMONAS AERUGINOSA. B. W. Holloway and Marilyn Monk (Univ. of Melbourne, Parkville, Victoria, Australia). p.231-7 of "Radiobiology." London, Butterworths, 1961.

Bacteriophage is propagated on Pseudomonas aeruginosa, and some of the phage particles produced by lysis of the donor bacterium have the capacity of transduction and include in their genetic structure a fragment of donor bacterial chromosome. When such a virus particle infects an acceptor strain differing from the donor strain in certain selected genetic traits, the genetic material from the donor strain is introduced into the acceptor bacterium and replaces the homologous section of the acceptor chromosome, a condition which is perpetuated in subsequent generations. Thus some of the acceptor bacteria permanently acquire genetic characteristics from the donor bacterium. A variety of genetic markers can be transduced but usually only one marker is transferred at a time, indicating that the potential load of bacterial genome carried by the phage is limited. Transduction is thus an interaction between three genetic systems. Ultraviolet irradiation of transducing phage preparations was found to increase the frequency of successful transductions. Reaction mechanisms involved are discussed. (C.H.)

30519 SOME EFFECTS OF X-IRRADIATION ON THE ENDOGENOUS AND AUXIN INDUCED GROWTH OF ETIOLATED PEA STEM TISSUE. John W. King and Arthur W. Galston (Yale Univ., New Haven). p.238-42 of "Radiobiology." London, Butterworths, 1961.

Results are reported from preliminary experiments on the effects of x radiation on the endogenous and auxin-induced growth of etiolated pea stem tissue. The results substantiate previous reports that the endogenous growth of such tissue is inhibitable by x irradiation. However, the auxin-induced growth is not only not inhibited by such treatment, but usually showed an increased growth at dosages of 10000 r or greater. (C.H.)

30520 THE USE OF IONIZING RADIATION IN THE STUDY OF IMMUNITY TO PARASITIC NEMATODES. W. Mulligan and D. F. Stewart (Commonwealth Scientific and Industrial Research Organization, Glebe, New South Wales, Australia). p.245-9 of "Radiobiology." London, Butterworths, 1961.

The life cycle of the cattle lungworm involves an extensive systemic migration in the host. Irradiated larvae were found to exercise their immunogenic effect although they do not develop into adults. The use of irradiated larvae was found to be a satisfactory method of protecting cattle against lungworm infection in the United Kingdom. Results are reported from studies of immune reactions in a host to infection by parasitic nematodes. (C.H.)

30521 RESULTS OF ASSESSMENT OF IRRADIATION RESPONSE IN THE TREATMENT OF CARCINOMA OF THE UTERINE CERVIX BY EVALUATION OF SERIAL BIOPSIES. K. A. McGarrity and J. M. Garvan (Univ. of Sydney and St. Vincent's Hospital, Sydney). p.250-69 of "Radiobiology." London, Butterworths, 1961.

Results are reported from a survey on the response of carcinoma of the uterine cervix during various stages to treatment by surgery alone, irradiation alone, and irradiation combined with surgery. Photographs of serial biopsies are included. (C.H.)

30522 EXPERIMENTS IN PHOTOSENSITIVITY. V. J. McGovern (Royal Prince Alfred Hospital, Sydney). p.270-5 of "Radiobiology." London, Butterworths, 1961.

Both humans and animals become excessively sensitive to light under certain circumstances. Results are reported from a study of factors affecting photosensitivity in albino rats treated with various drugs. (C.H.)

30523 COMPARISON OF THE BIOLOGICAL EFFECTS OF X-RAYS AND RADIOMIMETIC CHEMICAL AGENTS. P. C. Koller (Royal Cancer Hospital, London). p.281-6 of "Radiobiology." London, Butterworths, 1961.

The cytological effects of nitrogen mustard treatment were compared with the effects of various doses of x radiation on the cells of transplanted Walker carcinoma of the rat. A study of growth inhibition of transplanted mouse tumor after the administration of a mustard derivative of the natural amino acid of phenylalanine gave further evidence to show that besides direct effect on chromosomes, indirect effects also play a role. Many similarities were found in the end products of nitrogen mustard and x ray treatment. However, in view of the dissimilarities found, it is concluded there are differences in the mode of action of alkylating agents and x rays. (C.H.)

30524 MECHANISMS OF THE CYTOTOXIC ACTION OF THE RADIOMIMETIC ALKYLATING AGENTS. Peter Alexander (Royal Cancer Hospital, London). p.287-97 of "Radiobiology." London, Butterworths, 1961.

Results are reported from experiments which indicate profound differences in the biological effects of different alkylating agents. Data are presented from measurements of the action of dimethyl myleran and nitrogen mustard on leukemia cells in tissue culture. (C.H.)

30525 A COMPARISON OF THE EFFECTS OF RADIOMIMETIC DRUGS AND RADIATION ON HAEMOPOIESIS IN THE RAT. D. A. G. Galton (Royal Cancer Hospital, London). p.298-302 of "Radiobiology." London, Butterworths, 1961.

The biological effects of two dissimilar alkylating agents, chlorambucil and busulphan, were compared with the effects of x radiation. The dynamics of the processes of damage and repair in the hematopoietic organs of the rat was used as a criteria of biological effects. (C.H.)

Radiation Sickness

30526 (A/AC.82/G/L.634) BELKOVYI OBMEN I IMMUNOLOGICHESKIE OSOBENNOSTI KLETOCHNYKH ORGANOIDOV PRI OSTROI LUCHEVOI BOLEZNI. (Albumin Metabolism and the Immunogenic Characteristics of Cell Organoids in Acute Radiation Sickness). L. I. Il'ina and R. V. Petrov (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). Aug. 28, 1961. 8p.

The quantity and rate of albumen fraction synthesis in nuclei (desoxyribonucleoprotein, acid, and residual albumin), mitochondria, and microsomes of liver and small intestine were studied in 190 to 210 g white rats irradiated with 800 r. The data indicate a disturbance of albumen metabolism in all cells and the appearance of antigen properties in the cytoplasmic granules as well as an increase in toxicity related to various pathological reactions. (R.V.J.)

30527 (NP-10650(p.41-80)) PHARMACOLOGICAL AND TOXICOLOGICAL COMPOUNDS AS PROTECTIVE OR THERAPEUTIC AGENTS AGAINST RADIATION INJURY. I. THE INFLUENCE OF VARIOUS CHEMICAL COMPOUNDS ON RADIATION LETHALITY IN MICE. V. Plzak, M. Root, and J. Doull (Chicago. Univ. Air Force Radiation Lab.).

A total of eighty chemical compounds were tested for protective activity against radiation lethality in mice. Nearly half of these compounds exhibited some degree of protective effect and about one-fourth of the compounds permitted 20% or more of the treated mice to survive a lethal dose of whole-body x irradiation. The most pronounced radioprotective effects were obtained with 2-ethylthio-4-amino-6-oxypyrimidine (EL-113) which produced a 30-day survival of 50%. Forty per cent of the animals treated with alpha-ethylmercaptoisobutyramide (HL-2), ethyl-N-(p-chlorophenyl) carbamate (EL-114) and with 1,2-diaminocyclohexane tetraacetic acid (GE-6) survived the 700 r x-ray exposure. Thirty-day survivals of 30% were obtained following the pre-irradiation administration of the hydroxyethyl ether of ortho-phenyl-phenol (BE-18) and of betanaphthol (BE-19) and with hydroxyethyl benzyl ether (BE-17), 1,6-bis(p-aminomethylphenoxy) hexane (EL-125), p-acetylaminoacetophenone thiosemicarbazone (EL-140), and with 4-(2-dimethylaminoethoxy)-N-(3,4,5-trimethoxybenzoyl) benzylamine (HL-12). Several of the other compounds included in the present study markedly increased the median survival time of the x-rayed mice or permitted 10% to 20% of the x-rayed animals to survive for 30 days after the radiation exposure. Preliminary studies were initiated to investigate the effect of the solvent used for preparing the injection solutions on the radioprotective activity of various chemical agents. (auth)

30528 (NP-10650(p.81-97)) PHARMACOLOGICAL AND TOXICOLOGICAL COMPOUNDS AS PROTECTIVE OR THERAPEUTIC AGENTS AGAINST RADIATION INJURY IN EXPERIMENTAL ANIMALS. II. DOSE-MORTALITY RELATIONSHIPS FOR SEVERAL RADIOPROTECTIVE COMPOUNDS. J. Doull, V. Plzak, and M. Root (Chicago. Univ. Air Force Radiation Lab.).

Preliminary studies of the effect of mercaptoethylamine, 2-aminoethylisothiourea, serotonin, and p-aminopropiophenone on the dose-mortality relationships of CF_1 female mice exposed to single doses of whole-body x irradiation were carried out in order to provide a more precise means for comparing the radioprotective activity of these and other agents. The increase in the LD_{50} (30-day) for single whole-body x-ray exposure was used to calculate the dose reduction factor for each of the four agents and it was found that 2-aminoethylisothiourea exhibited the most marked radioprotective effect (DRF = 1.7) followed by serotonin (DRF = 1.6), mercaptoethylamine (DRF = 1.4), and p-aminopropiophenone (DRF = 1.3). The results of the present studies suggested that 2-aminoethylisothiourea is more effective in preventing radiation lethality in the lethal range whereas mercaptoethylamine, serotonin, and p-aminopropiophenone appeared to exhibit a fairly constant radioprotective effect throughout the range of 600 r to 1000 r. The LD_{50} (30-day) for single whole-body x-ray exposure has been investigated for 101 × C3H female mice and studies of the effect of radioprotective agents on the dose-mortality relationships within this strain have been initiated. (auth)

CHEMISTRY

General and Miscellaneous

30529 (K-436(Del.)) VISCOSITY, DENSITY AND COMPOSITION OF URANIUM HEXAFLUORIDE AND CHLOROTRIFLUOROETHYLENE LIQUID POLYMER SOLUTIONS. J. L. Gabbard and R. E. McHenry (Carbide and Carbon Chemical Corp. K-25 Plant, Oak Ridge, Tenn.). July 15, 1949. Decl. with deletions Oct. 21, 1959. Contract W-7405-eng-26. 16p.

A study of the solutions of uranium hexafluoride and chlorotrifluoroethylene liquid polymers was made with the purpose of relating the vapor pressure to the viscosity, density, and composition of the solution. The measurements were made at 60°C from 0 to 650 mm mercury pressure. The viscosity and density were found to be parabolic functions of the vapor pressure of the solution. The addition of uranium hexafluoride decreases the viscosity and increases the density of the solution. The rate of decrease of the viscosity diminishes with increasing concentration of uranium hexafluoride while the rate of increase of the density increases. The solution was non-ideal and deviated from Raoult's law. The composition and vapor pressure were related by the Margules equation. (auth)

30530 (NAA-SR-6466) THE MAXIMUM SOLUBILITY OF WATER IN POLYPHENYLS. H. Mandel (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Sept. 15, 1961. Contract AT-11-1-GEN-8. 16p.

The maximum solubility of water in ortho-terphenyl and in three polyphenyl mixtures was determined experimentally over the temperature range 175 to 570°F using the cloud point technique. The water solubility characteristics of the four materials tested, including one sample which contained a small fraction of radiolytic high boiler, were found to be approximately the same, increasing from 0.25 wt % at 175°F to 9.0 wt % at 570°F. The experimental data were evaluated in terms of Henry's law and were found to show a reasonable correlation over the temperature range 350 to 570°F. The Henry's law constants so determined can be used to calculate the partial pressure of the water in the vapor at water solubilities at and below the maximum over this temperature range, and at somewhat higher temperatures by extrapolation. (auth)

30531 (TID-13816) ELECTROCHEMICAL REDUCTION OF PYRIMIDINE, CYTOSINE AND RELATED COMPOUNDS: POLAROGRAPHY AND MACROSCALE ELECTROLYSIS. Report No. 63. David L. Smith and Philip J. Elving (Michigan. Univ., Ann Arbor). Sept. 1, 1961. Contract AT(11-1)-70. 41p.

The electrochemical reduction of pyrimidine and certain derivatives was investigated over the normal pH range by polarography, coulometry, and macroscale electrolysis. The reduction products were examined chemically, polarographically, and spectrophotometrically. Pyrimidine is first reduced at the 3,4 position in a 1e process to a free radical, which may dimerize or be reduced (1e process) to 3,4-dihydropyrimidine; the latter can be further reduced (2e process) to tetrahydropyrimidine. The 2-amino- and 2-amino-4-methylpyrimidines are reduced in two 1e steps, first to a free radical and then to the 3,4-dihydro derivative. 4-Amino-2,6-dimethylpyrimidine gives a single 4e wave, which likely involves 2e reduction to the 3,4-dihydro compound followed by deamination to 2,6-dimethylpyrimidine, which is reduced (2e process) to 2,6-dimethyl-3,4-dihydropyrimidine. Cytosine (4-amino-2-hydroxypyrimidine) undergoes a 3e reduction, which involves 2e reduction of the 3,4 N = C bond, deamination to form 2-hydroxypyrimidine and 1e reduction of the latter to a free radical which dimerizes. 2-Hydroxypyrimidine itself shows only 1e reduction. The dihydro and tetrahydro products are unstable in aqueous solution; pseudo first-order rate of disappearance is shown by the two compounds examined. In general, 4-amino-pyrimidines having the 3,4 position hydrogenated deaminate readily to generate the reducible 3,4 N = C bond. (auth)

30532 (UCRL-9579) INORGANIC MATERIALS DIVISION ANNUAL REPORT, 1960. (California. Univ., Berkeley. Lawrence Radiation Lab.). Feb. 21, 1961. Contract W-7405-eng-48. 132p.

Activities in an inorganic materials program concerned with the material environment in which atomic energy processes can be carried out most effectively are described. Research is directed primarily toward basic knowledge out of which new or improved solutions to these materials problems will arise. Considerable emphasis is placed on investigations of selected substances at very high temperatures. The investigations are directed primarily toward the mechanical and chemical properties of materials and toward the atomic factors which determine these properties. General principles are sought from which properties may be predicted for large groups of substances over wide temperature ranges and in different states of fabrication. Thermal, electrical and other properties are also being investigated. A section on the program in chemistry includes activities in high-temperature and general inorganic chemistry and in the physics and chemistry of the solid state. Another general section concerns work in the fields of ceramics and metallurgy. A third section concerns materials investigations in nuclear engineering which are barely under way at present. (auth)

30533 (AEC-tr-4498) TRANSACTIONS OF THE V. G. KHLOPIN RADIUM INSTITUTE. Translation of Trudy Radievogo Inst. im. V. G. Khlopina, 5: No. 2, 1957. 327p.

Included are 17 papers on the analytical chemistry of uranium, physicochemical problems of radiochemistry, the determination of absolute geological age, the geochemistry of radioactive elements, and techniques of making radioactivity measurements. Separate abstracts were prepared for each of the papers. A bibliography is presented of research papers from the Radium Institute of the Acad. Sci., USSR, "Transactions of the Radium Institute" of works published in 1938 and 1939. (B.O.G.)

30534 (AEC-tr-4498(p.20-31)) STABILITY AND FISSION OF HEAVY ATOMIC NUCLEI. V. V. Cherdyntsev. Translated from Trudy Radievogo Inst. im. V. G. Khlopina, 5: No. 2, 21-30(1957).

A discussion is given of the energies of fission and fragment excitation, which are: W_k, the kinetic energy of fission is of the order 150 Mev; W_β, the energy of the β radiation is ~30 Mev; and W_T, the excitation of heat energy of nuclear fragments manifested in the radiation of neutrons, γ quanta, and possibly charged particles is ~20 Mev. The stability of naturally radioactive nuclei is discussed for those near the maximum region of the α-decay curve for A = 208 to 240. Processes for neutron capture by the

nuclei and their subsequent decay chains are illustrated. (B.O.G.)

30535 (AEC-tr-4498(p.32-9)) APPLICATION OF THE COMPENSATION METHOD TO THE DETERMINATION OF ACTINIUM IN SMALL QUANTITIES. V. I. Baranov. Translated from Trudy Radievogo Inst. im. V. G. Khlopina, 5: No. 2, 31-6(1957).

The compensation assembly consisted of a Lutz-Edelman string electrometer and two identical ionization chambers charged to equal-and-opposite potentials by Clark normal-cell batteries. The compensation method was used to analyze solutions and powders for actinium on the basis of emanation. The results obtained were: natural scattering = 0.10 events/min; ionization current without additional volume, after subtracting natural scattering, I = 0.60 events/min; and ionization current with additional volume, after subtracting natural scattering, I = 0.32 events/min. (B.O.G.)

30536 (AEC-tr-4498(p.40-68)) MEASUREMENT OF ACTIVE RADIUM AND ACTINIUM FILMS BY MEANS OF β-RAYS. E. S. Shchepot'eva. Translated from Trudy Radievogo Inst. im. V. G. Khlopina, 5: No. 2, 37-60(1957).

A description is included of a sensitive compensation apparatus for measurements of radioactive materials by their emanation of β rays. A theory of mathematical analysis of the curves of active radium films measured from β rays is derived, which may be used to determine the number of atoms of the radon-decay products present on a plate, provided the utilization factors, a_B and a_C for the β rays of RaB and RaC in an ionization chamber are determined beforehand. A method is given for determining the utilization factors. A description and results of the determination of the corrections to be introduced as a result of the deficiency of absolute saturation in the ionization chamber during measurements with α rays are given, together with the results of checking the remaining measured quantities for capacity and sensitivity. A theory was developed for the analysis of the curves of active actinium films measured with α and β rays. A mathematical method is outlined of analyzing mixed active film curves measured with α rays. Theoretical curves for an active film of radium, measured with β rays, and for actinium, measured with α and β rays, were calculated for different ratios of the radioelements forming the active film. (B.O.G.)

30537 (AEC-tr-4498(p.69-98)) ADSORPTION OF SHORT-LIVED PRODUCTS OF RADON DECAY FROM WATER ON GLASS. E. S. Shchepot'eva. Translated from Trudy Radievogo Inst. im. V. G. Khlopina, 5: No. 2; 61-88(1957).

The equation for the rate of formation of adsorbed gaseous layers was applied to the adsorption of solids from sufficiently dilute solutions. The adsorption measured as a function of time allows the determination of the basic values characterizing desorption. The value of k, the mean probability per second for the evaporation of an individual atom, was found dependent on the electric forces of interaction between the adsorbed atom and the solid surface. In sufficiently great dilutions, the values of $M = \alpha\mu$, the number of atoms settling each second on the solid surface, do not appear to depend on electric forces. The accumulation of any radioelement from radon water on the surface of a solid caused by adsorption from water and transformation from a parent element proceeds quite independently and the adsorption equilibrium for each of the groups has its characteristic value. The adsorption of RaA on glass is a primary adsorption, and the desorption coefficient at room temperature and at great dilution is practically zero. The adsorption of RaB is secondary, adsorption in the second of even more remote layers, and takes place on adsorbed molecules of water and on oppositely charged ions. A characteristic of secondary adsorption is the dependence of the desorption coefficient, k, on the relative motion of the solid and the solution. Adsorption of RaC appears to be primary, but the desorption coefficient of the settling RaC is not zero. The maximum amount of adsorbed material, at equilibrium, is not determined by the cessation of settling from solution onto the solid, nor by what part of the solid surface is covered in the process, but exclusively by the values of k and M and by the numerical ratios derived from the latter. (B.O.G.)

30538 (AEC-tr-4498(p.99-105)) A METHOD OF DETERMINING BERYLLIUM IN ORES BY MEANS OF PHOTONEUTRONS. B. C. Aidarkin, G. V. Gorshkov, A. G. Grammakov, V. S. Zhadin, and A. G. Kolchina. Translated from Trudy Radievogo Inst. im. V. G. Khlopina, 5: No. 2, 89-93(1957).

The method consists of the irradiation of the ore with gamma rays and measuring the intensity of the induced radioactivity which is proportional to the beryllium content, and comparison of the measurements with a standard. To obtain accurate results, it is necessary to compare equal weights of sample and standard, while at the same time ensuring equal dimensions of the irradiated layer, to ensure that the densities do not differ significantly, and to assure that the respective beryllium contents do not differ by more than a factor of 5 to 10. Tests indicate that for increasing beryllium contents above 1% the error decreases approximately as the square root of the concentration: at 0.45% content the error was 13%, at 5% content the error was 3%, and at 50% content the error will be ~1%. (B.O.G.)

30539 (AEC-tr-4498(p.106-18)) A STUDY OF BOTHE'S APPARATUS FOR DETERMINING Ra, MsTh AND RdTh IN MIXED PREPARATIONS. M. N. Rostova. Translated from Trudy Radievogo Inst. im. V. G. Khlopina, 5: No. 2, 94-104(1957).

A reconstruction and an analysis was made of a system analogous to Bothe's for the determination of Ra, MsTh, and RdTh in preparations where such determinations are possible. The evaluations of the standard curve made for relative radium equivalent and Bothe's curve were made using MsTh compounds, whose MsTh content was measured at preparation time by the emanation method. The results of the measurements show that the MsTh content in the preparations is higher than the 35% obtained by the emanation method, whereas the content is less than 35% when calculated from Bothe's curve. An accuracy of about 2% can be attained for determining MsTh in fresh preparations. (B.O.G.)

30540 (AEC-tr-4498(p.119-32)) POLAROGRAPHIC DETERMINATION OF URANIUM. I. E. Starik and A. S. Starik-Smagina. Translated from Trudy Radievogo Inst. im. V. G. Khlopina, 5: No. 2, 105-16(1957).

A series of experiments was conducted, in which uranyl nitrate was used in the presence of a variety of salts in acid and neutral media. When the acid solution of uranium is polarized, there is no U(VI) → U(V) reduction step; U(V) is directly reduced to U(IV), and then to U(III). The process, U(VI) → U(IV), was found to be the most stable and most constant. In neutral solutions and in the absence of salts, uranium forms an adsorption maximum, which makes its determination impossible. The effects of the presence of alkali metals, lead, aluminum, phosphoric acid, and vanadium on the determination were investigated. The sensitivity of the polarographic method is greater than that of

the colorimetric determination with the aid of sodium peroxide and potassium ferrocyanide. The method permits the absolute determination of uranium content from 8×10^{-4} to 2×10^{-5} g/l, with an accuracy of ±2%. (B.O.G.)

30541 (AEC-tr-4498(p.133-45)) DETERMINATION OF SMALL QUANTITIES OF URANIUM BY THE FLUORESCENCE METHOD. V. A. Unkovskaya. Translated from Trudy Radievogo Inst. im. V. G. Khlopina, 5: No. 2, 117-28(1957).

A discussion is given of the fluorescence method applicable to determining uranium contents of the order of 5×10^{-6}%. The method is evaluated by applying it to uranium determinations in petroleum, petroleum waters, and in rocks. (B.O.G.)

30542 (AEC-tr-4498(p.146-51)) CHROMATE METHOD OF DETERMINING SMALL QUANTITIES OF LEAD. I. E. Starik and F. E. Starik. Translated from Trudy Radievogo Inst. im. V. G. Khlopina, 5: No. 2, 129-33(1957).

A method was developed for separating and determining small amounts of lead, which is applicable to easily soluble minerals and rocks, as well as to natural waters. The great advantage of the method is that it excludes the use of sulfuric acid, which is difficult to separate from lead. The method allows the separation of 90% of lead in cases where other methods are of little value. The development of a polarographic method for determining lead in the presence of chromium permits the electrolytic separation of lead. The chromate method appears to be applicable to the separation of radium. (B.O.G.)

30543 (AEC-tr-4498(p.152-67)) ADSORPTION OF RADIUM ON LEAD SULFATE. V. I. Grebenshchikova. Translated from Trudy Radievogo Inst. im. V. G. Khlopina, 5: No. 2, 134-47(1957).

An investigation was made of the primary adsorption of isomorphous ions as a function of their concentration in solution and of the surface charge. A precipitate of $PbSO_4$ was used as the adsorbent while the adsorbate was in the form of radium ions which can enter isomerically into the lattice as the adsorbent crystal. The surface charge of the adsorbent was varied by adding to the suspension small amounts of H_2SO_4 and $Pb(NO_3)_2$. The results indicate that the surface area of the adsorbent was constant in all cases reviewed, and consequently, there is no other process associated with the adsorption of isomorphous ions other than a kinetic interchange with ions on the surface. (B.O.G.)

30544 (AEC-tr-4498(p.168-75)) COLLOIDAL SOLUTIONS OF RADIOELEMENTS. A. P. Ratner, N. G. Rozovskaya, and V. Gohkman. Translated from Trudy Radievogo Inst. im. V. G. Khlopina, 5: No. 2, 148-54(1957).

A study was made of the centrifuging and ultrafiltration of solutions of polonium and thorium at different pH values. Two groups of particles were shown to be present in the solutions, with dimensions of the order 30 to 40 μ, and ~1 μ, respectively. The coarsely dispersed particles were found to pass slowly through a dialyzer, whereas the finely dispersed particles did not. The suggestion was made that the coarsely dispersed particles represent the radioelement adsorbed on impurities, whereas the fine particles are composed of radioelements alone. Certain properties of colloidal solutions of radioelements are discussed. (B.O.G.)

30545 (AEC-tr-4498(p.176-205)) THE HEAT OF DIFFUSION OF HELIUM AS A CRITERION OF THE SUITABILITY OF MINERALS FOR THE DETERMINATION OF AGE BY THE HELIUM METHOD. E. K. Gerling. Translated from Trudy Radievogo Inst. im. V. G. Khlopina, 5: No. 2, 155-83(1957).

A review is included of studies of the diffusion of helium in rocks. The heat of diffusion characterizes the energy state of helium and of the atoms of ions of the solid, at which the diffusion from one crystal cell to another takes place. The suitability of a mineral for the determination of age by the helium method can be determined from the value of the heat of diffusion. The amount of helium lost by a mineral decreases with increases in the heat of diffusion value. Extraneous admixtures facilitate the diffusion, since the heat of diffusion associated with the migration along dislocations is less than the value corresponding to the migration from the mineral lattice. Helium was established to be present in minerals in different positions, evolution, from which, is associated with different activation energies. Energetic characterizations are given for four of the five helium positions established for monazite. The degree of pulverization of homogeneous crystals was found to have no decisive influence on the determination of heats of diffusion. (B.O.G.)

30546 (AEC-tr-4498(p.206-26)) EMANATING POWER OF MINERALS. I. E. Starik and O. S. Melikova. Translated from Trudy Radievogo Inst. im. V. G. Khlopina, 5: No. 2, 184-202(1957).

The emanating power of several radioactive minerals was determined for constant conditions of temperature, pressure, humidity, and particle size, and was used to compile tables of the emanation power of uranium and thorium minerals. The variations in the emanation coefficients (K) for different forms of minerals are K = 0.10 to 98.5%. The coefficient varies for different specimens of the same mineral, since the formation of crusts within the mineral causes the value of K to increase. The coefficient of a given mineral depends on the degree of preservation of the specimen, and the available data suggest that the emanating power is greater for damaged zones. No corresponding increase in emanating power is observed in the case of khlopinite, when the surface area of the mineral is increased, which apparently is caused by the diffusion character of the evolution of emanation. Emanation is found to play an important role in α and β measurements on specimens containing thorium and uranium. The study of emanation from minerals and rocks is considered of great importance in age determination and in emanation surveys. (B.O.G.)

30547 (AEC-tr-4498(p.227-40)) DETERMINATION OF THE GEOLOGICAL AGE OF CERTAIN MINERALS AND ROCKS FROM KHIBIN AND THE NORTHERN REGIONS OF THE KARELIAN ASSR BY THE LEAD METHOD. V. M. Permyakov. Translated from Trudy Radievogo Inst. im. V. G. Khlopina, 5: No. 2, 203-16(1957).

Descriptions are included of methods used in the analysis of lovchorrites, loparites, monazites, aplite-granite, and microcline for lead, thorium, and uranium. The geological age (in years) of the minerals was calculated from the equations: for minerals and rocks rich in uranium, $\underline{t} = 1.44 \times 10^{10} \log [1 + (1.155Pb/U + 0.36Th)]$; and for minerals and rocks rich in thorium, $\underline{t} = 4.345 \times 10^{10} \log [1 + (1.155Pb/Th + 2.78U)]$. (B.O.G.)

30548 (AEC-tr-4498(p.241-53)) PHYSICOCHEMICAL AND RADIOLOGICAL STUDIES OF THE HOT MOUNTAIN OF YANGAN-TAU IN THE BASHKIR ASSR. B. A. Nikitin. Translated from Trudy Radievogo Inst. im. V. G. Khlopina, 5: No. 2, 217-29(1957).

The physical and chemical tasks of the study comprised a precise measurement of temperature anomalies and the determination of the chemical composition and radioactivity of gases emerging from the mountain, and of the waters of

springs emerging in the vicinity of the mountain. The maximum temperature recorded on four fire terraces, clearings on the mountain, was 144°C. The radium emanation content of gases and vapors collected from cracks in the hill was found to be 1 Mache unit in vapors, and 0.4 Mache unit for dry gases. Analyses of the vapors revealed a significant CO_2 content, to 6%, and indicated that organic matter was being oxidized in the cracks. In one fast flowing spring the radium emanation content was found to be 17 Mache units. No air conductivity anomalies were found in the vicinity of the hill. (B.O.G.)

30549 (AEC-tr-4498(p.254-79)) GEOCHEMISTRY OF RADIOACTIVE ELEMENTS IN THE PEGMATITIC FIELD OF NORTHERN KARELIA IN CONNECTION WITH THE PROBLEMS OF THE AGE OF THE WHITE SEA INTRUSIONS. L. V. Komlev. Translated from Trudy Radievogo Inst. im. V. G. Khlopina, 5: No. 2, 230-55(1957).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 8612.

30550 (AEC-tr-4498(p.280-314)) WATER AND GAS CONTENT IN CARBURAN. S. M. Popov. Translated from Trudy Radievogo Inst. im. V. G. Khlopina, 5: No. 2, 256-86(1957).

Carburan was found to represent a four-variety mixture, for which Nos. 1, 3, and 4 possessed sharp peculiarities. No. 2 is individual in some respects, while it resembles either No. 1 or No. 3, and appears to be a transition between the former and the latter. The differences are manifested in specific gravities, ash and moisture content, and gas evolution. The water evolved from Nos. 1 and 3 displayed a common point at 325°C, which points to the presence of both specimens of identical mineral compounds, decomposition of which is accompanied by formation of water. Spectroscopic studies show an almost identical qualitative composition of all the types. Total volatile content of the types, in numerical order, is: 69.70; 67.40; 48.02; and 46.07%, respectively. The qualitative composition of evolved gases is the same except that No. 4 evolved no oxygen. The initial and final temperatures and the character of CO_2 evolution may allow an approach to a graphical solution of the amounts of calcium, lead, magnesium, and uranyl carbonates present in the mineral. Calcining in the absence of oxygen for ash analysis and uranium valency determinations should be done below 650°C, since higher temperatures are accompanied by reactions involving changes in uranium valency. A discussion is included of the analysis of thucholite minerals for water, carbon, and ash content. (B.O.G.)

30551 (AEC-tr-4809) OXIDATION OF SULFUR VAPOR AT LOW PRESSURES. N. Semenoff and G. Rjabinin. Translated by L. L. Smith (Savannah River Lab., Aiken, S. C.) from Z. physik. Chem. (Leipzig), 1B: 196-204(1928). 10p.

The theory of chain-forming processes in thermal reactions was verified for the case of oxidation of sulfur vapor. It was found that the oxidation of sulfur vapor proceeds only in a very definite interval of O_2 pressure. This interval varied with increasing temperature which in turn determined the pressure of the sulfur vapor. The rate of oxidation was independent of oxygen pressure. It appeared to be determined more by the rate of vaporization of the sulfur. It was assumed that either ozone molecules or oxygen atoms are active centers in the reaction. (M.C.G.)

30552 (AEC-tr-4819) DIFFICULTY SOLUBLE POTASSIUM AND SODIUM DECAVANADATES. A New Precipitant for Sodium. G. Schwarzenbach and G. Geier. Translated by Lydia Venters (Argonne National Lab., Ill.) from Helv. Chim. Acta, 44: No. 3, 859(1961). 9p.

Solutions with pentavalent vanadium between pH3 and 5.5 were found to contain only decavanadate ions in the forms of $H_2V_{10}O_{28}^{4-}$, $HV_{10}O_{28}^{5-}$, and $V_{10}O_{28}^{6-}$. The crystallized sodium and potassium decavanadates containing the ions $V_{10}O_{28}^{6-}$ and $HV_{10}O_{28}^{5-}$ were highly soluble salts. The double salts $K_5NaV_{10}O_{28} \cdot 10H_2O$ and $K_4NaHV_{10}O_{28} \cdot 10H_2O$ were so sparingly soluble that they can be used for the quantitative precipitation of sodium. From solutions with a ratio K: Na = 10,000 : 1 the precipitates obtained had an exact stoichiometric composition. (auth)

30553 (AEC-tr-4829) DISSOLUTION RATES OF IRON AND ALUMINUM IN AQUEOUS HYDROCHLORIC ACID SOLUTIONS. T. G. Owe Berg. Translated from J. chim. phys., 51: 141-60(1954). 31p.

The dissolution rates of impure iron and aluminum in aqueous HCl solutions were measured from 0 to 65° and from 1 to 13N. Ecmpirical relationships between the dissolution rate v, acid concentration c, and temperature T, which lead to the dissolution mechanism, were derived. The process which controled the dissolution rate of iron was the dissolution of $FeCl_2$ by hydrolysis. The portion of the metal surface which was coated with $FeCl_2$ was determined by the equilibrium between the reactions on the surface and in the solution. It was proportional to the square root of the adsorption rate of the ionized HCl molecules. For aluminum, the rate obeyed different laws for the different concentration regions. In a region, v was proportional to c^2. It was concluded from this that the dissolution rate of aluminum is controlled by the dissolution of $Al(OH)_3$. The activation energy was independent of c. At higher temperature concentrations, v was proportional to c. In this region the dissolution rate of aluminum was controlled by removing the hydrogen adsorbed on the metal surface. At c = 10.1N, v rapidly decreased by a factor of from 10 to 100, due to the adsorption on the surface of the metal of nonionized HCl molecules which do not react with the aluminum. (auth)

30554 (DEG-Inf-Ser-162) THE THEORY OF GAS CHROMATOGRAPHY. A. A. Zhukhovitskii (Zhuckovitsky). Translated by A. G. Hamlin (U.K.A.E.A., Capenhurst Works, Capenhurst, Ches., Eng.) from Uspekhi Khim., 28: 1201-15(1959). 23p. (Includes original, 8p.).

The current state of the theory of gas chromatography is reviewed. The fundamental objectives of the theory of chromatography appeared to be the velocities of motion of the band and the dependence of the widths of the bands on the time parameters of the experiment. Three groups of theories are outlined: the concept of theoretical plates, the kinetic theory, and the theory of macroscopic constants. The conduct of separate molecules was examined and the following characteristics introduced to define their behavior: mean time of residence on the adsorbent, the mean length of travel lengthwise along the bed of adsorbent, and velocity of adsorption. (M.C.G.)

30555 (NP-tr-746) FOUR YEARS OF PRACTICAL EXPERIENCE WITH CHLORINE DIOXIDE. O. Widemann. Translated by F. Hudswell (U.K.A.E.A., Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Vom Wasser, 24: 50-70(1957). 41p.

Phenolic contamination in the ground water resulted in troubles concerning odor and taste in the drinking water supply. The most quickly effective methods of treatment were sought for the elimination of these qualities. Complete removal of the phenolic odor and taste from the water

was achieved with chlorine dioxide. As a consequence, two chlorine dioxide plants, working by different processes, were installed for treating the water at about 600 l/sec. A third plant was later put into operation for sterilizing the drinking water. The technology and analysis for the chlorine dioxide process are described. (auth)

30556 (NP-tr-752) CHEMICAL REACTIONS ON THE SURFACE OF GERMANIUM, SILICON, AND THEIR ELECTRONIC ANALOGUES. O. V. Krylov and V. M. Frolov. Translated from Zhur. Vsesoyuz. Khim. Obshchestva, 5: 535-43(1960). 34p.

A discussion is presented of chemisorption, phase formation, and catalytic reactions in relation to processes that occur on semiconductor surfaces. It is noted that properties of semiconductor rectifiers and amplifiers are to a great degree determined by these reactions. Aspects examined include electronic processes of chemisorption, chemisorption on Ge, Si and other Ge analogs, and catalytic reactions on surfaces of Ge and its analogs. (J.R.D.)

30557 (NP-tr-763) THE SPECTRA OF TRIVALENT THULIUM. H. Gobrecht. Translated by W. G. Perkins (Univ. of New Mexico, Albuquerque) from Ann. Physik (5) 31: 600-8(1938). 9p.

The absorption and emission spectra of trivalent thulium were studied. For the absorption measurements $Tm_2(SO_4)_3$ was used. The emission spectra were taken using 3 preparations: a borax bead prepared with thulium, a K_2SO_4-Tm phosphor, and a CaO–Tm phosphor. Assignments were made of the observed terms in the following ways: by observing the total splitting of calculated term intervals, by comparison with the spectra of La-II and Pr-IV, and by calculation of the positions of all terms according to the methods of Slater, Condon, and Shortley. (M.C.G.)

30558 (NP-tr-765) PHYSICO-CHEMICAL PRINCIPLES OF VACUUM-THERMIC TREATMENT OF LITHIUM. T. F. Fedorov and F. I. Shamray. Translated from Primenenie Vakuuma Met. Akad. Nauk S.S.S.R., Inst. Met. im. A. A. Baikova, Trudy Soveshchaniya, Moscow, 1960, p.137-42. 17p.

The silico-thermic reduction of lithium oxide and alumino-thermic reduction of lithium aluminate at equilibrium were studied by the outflow method. A functional relationship between isobaric potential and temperature was established for lithium orthosilicate and lithium monoaluminate formation. Standard enthropy and enthalpy values were derived for these compounds. The method of continuous weighing was used to study the kinetics of aluminothermy with respect to lithium aluminate. The time period dominated by the kinetic factor was defined. The metal produced by vacuum alumino-thermy exceeded in purity the electrolytic product. Black electrolytic lithium was refined in a bubble cap column. The effectiveness of this refining method was demonstrated. (auth)

30559 (NP-tr-771) DIMINUTION OF THE POLARIZATION OF THE FLUORESCENCE OF SOLUTIONS RESULTING FROM THE BROWNIAN MOVEMENT OF ROTATION. Francis Perrin. Translated by G. A. Crosby (Univ. of New Mexico, Albuquerque) from Acta Phys. Polon., 5: 335-47(1936). 12p.

A discussion is given of the development of a theory for the polarization of the fluorescence of a dilute solution. The discussion is outlined in terms of: the general characteristics of the polarization of the fluorescence of solutions; the composition of fluctuating rotations for Brownian movements; the theory of the polarization of the fluorescence of solutions; and the possibility of circular polarization in molecular fluorescences. Experimental verifications were made for: values of the fundamental polarization p_0 deduced from the extrapolation of measurements relative to some very viscous solvents; the mean lives of the activated molecules determined from the study of solutions of medium viscosity; and the maximum mean life of a single electron. (B.O.G.)

30560 (PA-Trans-51) THE BINARY SYSTEM $NaClO_4$–$Ba(ClO_4)_2$. A. A. Zinov'ev (Zinov'yev), L. I. Chudinova, and L. P. Smolina. Translated for Picatinny Arsenal, Dover, N. J. from Zhur. Neorg. Khim., 1: 1850-6 (1956). 11p.

The polymorphism of anhydrous perchlorates of barium and sodium and also the binary system composed of these was studied by means of differential-thermal analysis with a recording of the heating and cooling curves using the N. S. Kurnakov pyrometer. Data were obtained which point out the existence in $Ba(ClO_4)_2$ of three polymorphous modifications. Confirmation was obtained of a change point at 280°C and a previously unknown change was found at 360°C. Confirmation was obtained of the polymorphous change of $NaClO_4$ with a change point at 308°C. The $Ba(ClO_4)_2$–$NaClO_4$ system was characterized by a simple eutectic with a change point related to the polymorphous change of $Ba(ClO_4)_2$. (M.C.G.)

30561 (UCRL-Trans-673(L)) A NEW METHOD OF DETERMINING THE TRANSPORT NUMBER OF IONS BY USING RADIOACTIVE TRACERS. I. THEORETICAL CONSIDERATIONS. Alexander S. Despic. Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Livermore) from Glasnik Khem. Drushtva, Beograd, 21: 9-18(1956). 14p.

A solution of radioactive cations of a known isotopic composition can be placed in the anode compartment of an electrolytic cell containing a membrane, while the cathode compartment can be filled with an inactive solution of the same ionic concentration. If the electrolysis is carried out, a certain amount of radioactivity will pass through the membrane towards the cathode and this will be a direct measure of the amount of electricity transported by the labeled ionic species. This can be used for the determination of the transport number of the species in the membrane. The method proposed would be free of well-known shortcomings of the standard methods. The phenomenon of self-diffusion of the radioisotope through the membrane was also considered and it was shown that by means of an adequate quantitative treatment its influence on the measured transport number values could be eliminated. (auth)

30562 CHLORINATION OF URANIUM OXIDES. G. Jangg, W. Ochsenfeld, and A. Burker (Technische Hochschule, Vienna and Austrochematom-Kernbrennstoff-Gesellschaft, Linz, Austria). Atompraxis, 7: 332-6(Sept. 1961). (In German)

Uranium oxides can be converted to chloride at relatively low temperatures by means of reduction chlorination. The chloride is also suitable for reduction to uranium metal. With carbon tetrachloride as a chlorinating agent, uranium oxides react at 400°C. Uranium chloride is formed via the intermediate stage of oxychloride. At low temperatures the uranium chloride remains residual, but at working temperatures of over 500°C it can be distilled off for the most part. It is advantageous to replace carbon tetrachloride by mixtures of chlorine and methane, which behave like carbon tetrachloride during chlorination. If the ratio of chlorine to methane is more than 4:1, chlorination proceeds smoothly; at lower ratios soot is formed. Uranium ores can be chlo-

rinated like the pure oxide. However, except for silicon and aluminum oxide, almost all the accompanying substances, especially iron, calcium, and magnesium compounds, are also carried over into the chloride. Uranium chloride can be separated from these by distillation or fractional condensation. However, chlorination of uranium ores is economically feasible only if the ore has a relatively high uranium content, and there are no appreciable quantities of other chlorinatable minerals. (auth)

30563 THERMAL CONDUCTIVITY AND VISCOSITY OF ZIRCONIUM TETRACHLORIDE AND HAFNIUM TETRACHLORIDE VAPORS IN THE TEMPERATURE RANGE OF 300 TO 700°C. V. I. Tsirel'nikov, L. N. Komissarova, and V. I. Spitsyn (Moscow State Univ.). Doklady Akad. Nauk S.S.S.R., 139: 1389-91(Aug. 21, 1961). (In Russian)

The thermal conductivity of the vapors was determined by a "hot wire" technique. A thin wire, whose resistance at constant current strength depends on the temperature of the wire and hence on the thermal conductivity of the vapor, is heated electrically in an atmosphere of the vapor. The thermal conductivity of $ZrCl_4$ vapor varied from 4.31×10^{-5} at 300° C to 6.35×10^{-5} kal/cm-sec-deg at 500° C, while that of $HfCl_4$ vapor varied from 3.67×10^{-5} at 300° C to 4.89×10^{-5} kal/cm-sec-deg at 500° C. The viscosity was determined by measuring the rate of flow of the vapors through a capillary. The viscosity varied linearly with temperature. The viscosity values for $ZrCl_4$ were 1970×10^{-7} poises at 300° C and 3230×10^{-7} poises at 700° C. The viscosity of $HfCl_4$ was 2680×10^{-7} poises at 300° C and 4150×10^{-7} poises at 700° C. (TTT)

30564 THERMODYNAMIC PROPERTIES OF THE CERIUM OXIDES. F. A. Kuznetsov, V. I. Belyi, T. N. Rezukhina, and Ya. I. Gerasimov (Moscos State Univ.). Doklady Akad. Nauk S.S.S.R., 139: 1405-8(Aug. 21, 1961). (In Russian)

The thermodynamic properties of cerium oxides in the composition range of $CeO_{1.5}$ to CeO_2 were determined so as to obtain complete data for the cerium-oxygen system. The electromotive force of the cell CeO_x|solid electrolyte|Fe + wustite was measured at various temperatures. By combining the cell reaction with the reaction for formation of wustite from its elements, the free energy ($\Delta\bar{G}^0_{III}$) can be calculated for the differential reaction: $1/\delta\ CeO_x + 1/2\ O_2 \rightarrow 1/\delta\ CeO_{x+\delta}$. The free energy varied as a function of temperature: $\Delta\bar{G}^0_{III} = a + b\,T$. Values of a and b are tabulated for CeO_x for values of x from 1.581 to 1.96. Values of A and B are also tabulated for values of the oxygen dissociation pressure as a function of temperature: $\lg P_{O_2}$ (atm) = (A/T) + B. The equilibrium constants $K_p = P_{H_2O}/P_{H_2}$ were measured for the reduction of CeO_x by hydrogen according to the following reaction: $1/\delta\ CeO_{x+\delta} + H_2 \rightarrow 1/\delta\ CeO_x + H_2O$. Because of the pyrophoricity of the intermediate cerium oxides, all operations were performed in purified nitrogen. Since the free energy for the formation of water vapor is known, values of ΔG^0_{III} and P_{O_2} were calculated and tabulated. This data was found to be in good agreement with the recently published data of Brauer. An expression relating the free energy (ΔG^0_{VI}) as a function of temperature for the temperature range of 298 to 1273° K is presented for the reaction: $Ce_2O_3 + 1/2\ O_2 \rightarrow 2\ CeO_2$. Values of the free energy (ΔG^0_{VI}) and of the entropy (ΔS^0_{VI}) are tabulated. The entropy of Ce_2O_3 (S^0_{298}) was calculated as 30.8 entropy units. (TTT)

30565 STUDY OF THE RADIOACTIVE CONTAMINATION OF ISOTOPE PRODUCTS CONTAINING PHOSPHORUS-32 BY USING A HUMUS PREPARATION. Mária Szilágyi (Inst. of Nuclear Research, Hungarian Academy of Sciences, Debrecen). Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrecen), Közlemények, 3: 3-9(1961). (In Hungarian)

It has been previously established that humus columns absorb high atomic weight cations while letting the anions pass through. This method was used for determining the impurities present in three P^{32} preparations procured from abroad. The isotope solution, pH 6 to 7, was eluted through a 8-mm diameter glass tube filled with 0.75 g of purified peat to a height of 17 cm. By using a γ-spectrographic method it was established that the preparations contained extremely small amounts of Zn^{65}, Fe^{55}, Fe^{59} and Sb^{124}, the latter in its anionic form. One of the preparations contained also small amounts of Co^{60} which was unidentified by the supplier. (TTT)

30566 RETENTION OF THE TETRAVALENT U(IV) ON HUMUS MATERIALS. Ernö Brücher (Inst. of Nuclear Research, Hungarian Academy of Sciences, Debrecen). Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrecen), Közlemények, 3: 11-15(1961). (In Hungarian)

It has been established that the residues of organic materials are responsible for the 10^4-fold enrichment of U in the soil by means of ion exchange processes. However, in most of the previous studies hexavalent U solutions were used, therefore, in view of the possible reduction of U(VI) to U(IV) in the soil, the retention of the tetravalent U compounds was investigated by passing $U(SO_4)_2$ solution, prepared by the reduction of uranyl sulfate, through a humus column. The solutions were quite concentrated in order to saturate the retentive ability of the humus particles. In order to avoid the hydrolysis of the solution at higher pH values, the experiments were carried out in the pH range of 1 to 3.5. It was found that the humus has a high retentive capacity toward the tetravalent U. With increasing pH, the amount of U^{4+} ions retained increases at a faster rate than that of UO_2^{2+}. It was also established that the retention represents a reversible process, similar to that occurring in the case of UO_2^{2+}; strong acids passing through the column release the U in the form U^{4+}. The theory of geochemical enrichment of U developed for hexavalent U is applicable also for the tetravalent form of the element. (TTT)

30567 ELECTRON TRANSFER SPECTRUM OF CAESIUM RHODIUM(IV) HEXACHLORIDE AT RELATIVELY LOW WAVE-NUMBER. Chr. Klixbüll Jørgensen (Cyanamid European Research Inst., Cologny (Geneva), Switzerland. Mol. Phys., 4: 231-3(May 1961).

The dark green crystals of Cs_2RhCl_6 had electron transfer bands at lower wave-number than any other hexahalide complex yet studied. The transitions were compared to those occurring in analogous compounds. The influence of covalent bonding on the orbital energies is discussed. (auth)

30568 A NEW VALENCY OF TECHNETIUM. F. Baumgärtner (Technische Hochschule, Munich), E. O. Fischer and U. Zahn. Naturwissenschaften, 48: 478(1961). (In German)

By neutron irradiation of di-benzyl-molybdenum (O), a cation of technetium was obtained in carrier scale after β transformation of the Mo^{99}. The cation is stable in air and 2 N acids and electrolytes. On the basis of its origin and its chemical properties, the cation complex is probably dibenzyl-technetium(I). (J.S.R.)

30569 THE SOFT X-RAY EMISSION SPECTRA OF SODIUM, BERYLLIUM, BORON, SILICON, AND LITHIUM. R. S. Crisp and S. E. Williams (Univ. of Western Australia, Nedlands). Phil. Mag. (8), 6: 365-9(Mar. 1961).

Emission band forms of several elements obtained with a

photon-counting spectrometer were compared with previously published spectra. The sodium $L_{23}I(E)$ vs λ curve departed from the free electron parabola at energies less than about 1 ev from the Fermi limit in accord with the theoretical form. The sodium extrapolated band width was 2.6 ± 0.3 ev. In beryllium K there was no contribution of p states from the bottom of the overlapping second zone. Zone overlap was estimated at 1 to 2 ev. The extrapolated band width for boron K was estimated at 14.1 ± 0.8 ev. The L_{23} band of silicon differed from those previously published but was apparently not affected by the temperature or the purity of the silicon. The extrapolated width was 13.4 ± 0.8 ev. A strong line at 253 Å and a blue fluorescence which accompanied the lithium K spectrum are shown to be connected with the reaction with lithium of hydrocarbon molecules not condensed by the cold trap. (auth)

30570 THERMODIFFUSION OF Li ISOTOPES IN SOLID LITHIUM SULFATE. Kerstin Lindqvist and Arnold Lunden (Chalmers Tekniska Högskola, Göteborg). Z. Naturforsch., 16a: 626-7(June 1961). (In German)

The light lithium isotope was enriched at the hot end of a column of lithium sulfate by thermodiffusion. Because of the high self-diffusion coefficient of the lithium ions in the cubic modification of Li_2SO_4, the stationary final state was attained in several days. The Soret coefficient is 7.8 ± 0.9×10^{-5}/degree in the temperature range from 600 to 830°C. (tr-auth)

30571 MANUFACTURE OF RADIOACTIVE IODINE$_{131}$. Rene Constant (to Centre d'Etude de l'Energie Nucleaire, C.E.N.). British Patent 877,333. Sept. 13, 1961.

A method for irradiating Te to form I^{131} is outlined which is rapid and does not require chemical separation of I^{131}. In this method, a Te compound, particularly telluric acid, is irradiated with neutrons and then dissolved in acid solution, and I^{131} is separated by distillation or extraction. (D.L.C.)

30572 IMPROVEMENTS IN OR RELATING TO PROCESSES FOR ISOLATING RADIOACTIVE IODINE 131. (to N. V. Philips Gloeilampenfabrieken). British Patent 877,535. Sept. 13, 1961.

A simple process is outlined for isolating I^{131} produced by slow neutron irradiation of TeO_2. The process comprises the steps of suspending the irradiated TeO_2 in an aqueous acid solution, and maintaining the suspension at an elevated temperature under the boiling point of the solution, whereby I^{131} is expelled from the TeO_2 lattice into the solution. The expelled I^{131} may then be recovered by distillation. In the preferred embodiment of the process, a solution of H_2SO_4 containing H_2O_2 is used. (D.L.C)

Analytical Procedures

Refer also to abstract 30514

30573 (AERE-R-3675) THE DETERMINATION OF CAESIUM-137 IN URINE. G. M. Arkell and A. Morgan (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). June 1961. 14p.

A method is described for the determination of Cs^{137} in urine. Samples are passed through a column containing ammonium phosphomolybdate which acts as a highly specific cation exchanger for Cs. Details are given of the recovery of the Cs from the column and of its purification and isolation in a form suitable for beta counting. The possible use of urine analysis to monitor current fall-out Cs^{137} levels in diet and in the human body is discussed. Some examples of current levels are given. (auth)

30574 (CEA-1909) ANALYSE ISOTOPIQUE DU PLUTONIUM PAR SPECTROSCOPIE OPTIQUE. (Isotopic Analysis of Plutonium by Optical Spectroscopy). J. Artaud, M. Chaput, and S. Gerstenkorn (France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucleaires, Saclay). 1961. 16p.

Isotopic analyses of mixtures of plutonium-239 and -240 were carried out by means of the photoelectric spectrometer, the source being a hollow cathode cooled by liquid nitrogen. The relative precision is of the order of 2%, for samples containing 3% of Pu^{240}. The study of the reproductibility of the measurements should make it possible to increase the precision; the relative precision which can be expected from the method should be 1% for mixtures containing 1% of Pu^{240}. (auth)

30575 (IA-621) ANALYTICAL APPLICATIONS OF DELAYED NEUTRON EMISSION IN FISSIONABLE ELEMENTS. Saadia Amiel (Israel. Atomic Energy Commission, Tel-Aviv). May 1961. 61p.

A method is described for the sensitive, accurate, and fast determination of fissionable nuclides, such as U and Th, by measuring their delayed neutron emission after fission. The analysis can be carried out non-destructively and irrespective of chemical composition and physical form, since the measurement is not affected by other elements. Sensitivities of less than one microgram are obtained. The application of this method to analyses of U and Th, the determination of the isotopic composition of U and the assays of U^{233} in Th and Pu^{239} in U, as well as the possibilities for U–Th prospecting are discussed. Different experimental conditions for various applications are mentioned. (auth)

30576 (PG-Report-178) THE DETERMINATION OF THORIUM IN URINE. A. H. Helman (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England and United Kingdom Atomic Energy Authority. Engineering Group, Springfields, Lancs, England). 1961. 10p.

Thorium is concentrated by co-precipitation on lanthanum fluoride purified by extraction with 2-thenoyl trifluoroacetone and determined absorptiometrically as the morin complex. The method is suitable for the determination of thorium down to a level of about 1.3 μg per liter. (auth)

30577 (PG-Report-213) ANALYTICAL METHOD FOR THE DETERMINATION OF URANIUM IN PURE URANIUM NITRATE SOLUTIONS. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England and United Kingdom Atomic Energy Authority. Engineering Group, Springfields, Lancs, England). 1961.

A method was developed for the determination of uranium in pure uranium nitrate solutions. An aliquot of the sample was treated with ammonia solution. The precipitated ammonium diuranate was filtered off, dried, and ignited to U_3O_8 at 900°C. The U_3O_8 was then weighed. At the 6% U u/v level the precision was 0.04%. (M.C.G.)

30578 (PG-Report-214) ANALYTICAL METHOD FOR THE DETERMINATION OF SILICA IN URANIUM ORE CONCENTRATES. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England and United Kingdom Atomic Energy Authority. Engineering Group, Springfields, Lancs, England). 1961. 4p.

The sample is dissolved in acid and the silica dehydrated with perchloric acid. Silica is determined by the weight loss on treatment with hydrofluoric acid. At the 3.0% level the precision is 0.14% relative. (auth)

30579 (PG-Report-215) ANALYTICAL METHOD FOR THE DETERMINATION OF TOTAL URANIUM IN RESI-

DUES CONSISTING ESSENTIALLY OF MAGNESIUM FLUORIDE. (United Kingdom Atomic Energy Authority. Production Group, Springfield, Lancs, England and United Kingdom Atomic Energy Authority. Engineering Group, Springfields, Lancs, England). 1961. 8p.

Fluoride is removed by fuming with sulfuric acid and the residue leached with nitric acid. The uranium is extracted with ether after removal of sulfate and is determined absorptiometrically using hydrogen peroxide. The method as written is suitable for samples containing up to 0.8% uranium, but the range may be extended to 2% by dilution of the final volume to be measured. At the 0.25% level the precision is 0.04% relative. (auth)

30580 (PG-Report-229) ANALYTICAL METHOD FOR THE ABSORPTIOMETRIC DETERMINATION OF BORON IN URANIUM DIOXIDE POWDER AND SINTERED URANIUM DIOXIDE PELLETS. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England and United Kingdom Atomic Energy Authority. Engineering Group, Springfields, Lancs, England). 1961. 7p.

Sintered uranium dioxide pellets, ignited to U_3O_8, and uranium dioxide powder without pretreatment are dissolved in sulfuric acid in the presence of hydrogen peroxide. Boron is separated by distillation as methyl borate and determined absorptiometrically as rosocyanine. The range of the method is 0.1 to 1.5 micrograms boron, and, as written, is applicable to uranium dioxide powder containing 0.1 to 1.5 ppm boron and to sintered uranium dioxide pellets containing 0.02 to 0.3 ppm boron calculated on a uranium basis. Standard deviation at the 0.1 to 1 ppm levels is ±10%. (auth)

30581 (PG-Report-234) ANALYTICAL METHOD FOR THE DETERMINATION OF LANTHANIDE AND YTTRIUM FISSION PRODUCT ACTIVITIES IN VEGETATION, SEAWEED, FISH-FLESH AND NATURAL WATERS. (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England and United Kingdom Atomic Energy Authority. Engineering Group, Windscale, Cumb, England). 1961. 10p.

Lanthanide and Y fission products, in the presence of added La carrier, were radiochemically separated from other activities. The lanthanum was finally precipitated as oxalate and mounted on a counting tray. The β activity of the source was measured. The method was found to be suitable for the determination of lanthanide and Y fission product activities in area survey samples of vegetation, sea-weed, and fish-flesh, and also in natural waters. In the last type of sample several other isotopes may be determined on the same sample portion, and the method is therefore particularly useful when the sample size is limited or when the concentrations of these isotopes are very low. Large samples can be handled without resorting to tedious evaporation techniques. Detection limits are governed by natural background radiation which is dependent upon local conditions. The method has been applied to samples containing 25 to 2500 $\mu\mu$c of yttrium and lanthanide fission product activity per sample portion. (auth)

30582 (PG-Report-242) THE DETERMINATION OF THE TOTAL GAMMA-ACTIVITY OF SHORE SAND, SEA SILT, SEABED MUD, VEGETATION, SEAWEED, FISH FLESH AND NATURAL WATERS. (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England and United Kingdom Atomic Energy Authority. Engineering Group, Windscale, Cumb, England). 1961. 8p.

A method suitable for the determination of total gamma activity in area survey samples of shore sand, sea silt, seabed mud, vegetation, seaweed, fish flesh, and natural waters is described. The samples were converted into a suitable physical form for packing into one of two standard types of container. The total gamma activity of the sample source was then measured by a scintillation counter. (M.C.G.)

30583 (PG-Report-243) ANALYTICAL METHOD FOR THE DETERMINATION OF THE BETA-ACTIVITY DUE TO INDIUM-116 IN AN INDIUM FOIL NEUTRON DOSIMETER. (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England and United Kingdom Atomic Energy Authority. Engineering Group, Windscale, Cumb, England). 1961. 7p.

The β activity due to In^{116m} in an indium foil neutron dosimeter was determined by a counting technique using standard Geiger-Mueller thin end-window counting equipment through a total absorber thickness of 5 mg/cm^2. The method is applicable under normal background conditions to the determination of the β activity due to In^{116m} from 300 to 5000 dpm. (auth)

30584 (PG-Report-244) ANALYTICAL METHOD FOR THE DETERMINATION OF NIOBIUM-95 IN VEGETATION, SEAWEED, FISH-FLESH AND NATURAL WATERS. (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England and United Kingdom Atomic Energy Authority. Engineering Group, Windscale, Cumb, England). 1961. 10p.

Methods were developed for the determination of Nb^{95} in vegetation, seaweed, fish flesh, and natural waters. Samples of vegetation, seaweed, and fish flesh were ignited and the residues were leached with HNO_3 and HCl in the presence of Nb and Zr carriers. Lanthanides were removed as fluorides. The Nb was precipitated with NH_4OH. The precipitate was dissolved in a mixture of oxalic and nitric acids and the Nb was precipitated as metaniobic acid. The Nb was further purified, mounted on a counting tray, and the gamma activity determined. From natural waters, the Nb^{95} and its carrier were co-precipitated on larger amounts of Fe as hydroxides. After dissolution in HNO_3, the radiochemical purification was continued by the process used for the seaweed, fish flesh, and vegetation. (M.C.G.)

30585 (TID-13297) ANALYTICAL CHEMISTRY AT LOW CONCENTRATIONS. Fifth Annual Report. John T. Stock (Connecticut. Univ., Storrs). July 28, 1961. Contract AT(30-1)-1977. 46p.

Voltammetric and amperometric studies indicated the possibility of the accurate titration with potassium permanganate solution of low concentrations of nitrite ion. A determination of the solubility of LiCl in ethylenediamine systems containing known small concentrations of water indicated that the literature value for the solubility in anhydrous ethylenediamine is probably about 7% too high. An extensive examination of the argentometric amperometric titration of low concentrations of cyanide led to the development of two methods. One of these permitted the titration of cyanide without interference from large relative concentrations of chloride, bromide, and iodide, and of lower concentrations of hydroxyl and sulfide ions. A semiautomatic titrator was developed and yielded promising results. (auth)

30586 (WIN-123) DETERMINATION OF ACTINIUM IN URANIUM MILL EFFLUENTS. E. J. Baratta and M. H. Feldman (National Lead Co., Inc. Winchester Lab., Winchester, Mass.). June 1, 1961. Contract AT(49-6)-924. 16p.

A procedure is presented for the rapid determination of actinium specifically applicable for the determination of

the naturally occurring beta emitting actinium isotopes, Ac^{227} and Ac^{228} in uranium processing mill effluents. Ac^{227} predecessor of Ra^{223} and Ac^{228}, daughter of Ra^{228}, are of biological significance. The method is applicable to a variety of sample types, including natural waters and uranium mill effluent solutions. Determinations can be made at levels required in 10 CFR Part 20, and below. The actinium is precipitated with lanthanum carrier, dissolved, purified by solvent extraction, and finally decontamination on anion and cation exchange resins. The actinium is beta counted on a gas flow proportional counter to detect the weak beta emission of Ac^{227}. The Ac^{228} can be beta counted on either a proportional counter or G-M tube. In either case it is necessary to follow the six-hour half life of Ac^{228}. When both are present the Ac^{227} beta activity can be shielded out with absorbers and only the actinium-228 counted on a G-M tube. (auth)

30587 (WIN-125) ISOTOPIC ANALYSIS OF THORIUM IN MILL EFFLUENTS AND NATURAL WATERS. Summary Report, January 1959–September 1961. (National Lead Co., Inc. Winchester Lab., Winchester, Mass.). Sept. 30, 1961. Contract AT(49-6)-924. 133p.

An analytical procedure is presented for the determination of the six natural occurring alpha and beta emitting thorium isotopes. The total thorium is precipitated with lanthanum carrier, dissolved and/or solvent extracted depending on the relative amounts of other ions present. The concentration of each of the thorium isotopes are determined by beta counting the Th^{234} and Th^{231} and following the decay for twenty-four hours to differentiate the two betas, by pulse height analysis in the case of Th^{230} and Th^{232}, ingrowth of the Ra^{223} in the case of Th^{227} and Ra^{224} in the case of Th^{228}. Alternate methods are also presented for the determination of the alpha emitting thorium isotopes. Determinations can be made at concentrations in the range of Title 10, Part 20 Code of Federal Regulations. (auth)

30588 (AEC-tr-4820) DETERMINATION OF PLUTONIUM–URANIUM RATIO IN URANIUM PITCH ORE. I. E. Starik, A. P. Ratner, M. A. Pasvik, and F. L. Ginzburg (Ginsburg). Translated by Lydia Venters (Argonne National Lab., Ill.) from Geokhimiya, No. 2, 142-6(1957). 8p.

Two methods were developed for separating and purifying plutonium. Data obtained in the purification by using the coseparation of plutonium and uranyl diacetate and the extraction of plutonium with diethyl ether are presented. Methods for separation of protactinium, radium, and polonium are described. Pu^{239} was isolated from 2 kg of uranium pitch ore. The chemical output of plutonium during the isolation process equalled 33.3%. It was found that the plutonium–uranium ratio in the investigated pitch ore equals $(2.0 \pm 0.3) \times 10^{-11}$. (M.C.G.)

30589 (AEC-tr-4833) DETERMINATION OF ZIRCONIUM AND ITS COMPOUNDS IN THE ATMOSPHERE OF INDUSTRIAL PREMISES. M. S. Bykhovskaya. Translated from Gigiena Truda i Professional'. Zabolevaniya, 5: No. 6, 54-7(June 1961). 5p.

Optimum conditions were worked out for determining small quantities of Zr and its compounds in the atmosphere, using arsenazo, pyrocatechol, and alizarinsulfonic acid sodium salt. The sensitivity of the method is 3 to 5 μg per 25 ml solution for photometric and visual measurements, respectively. (D.L.C.)

30590 NEW PHOTOGRAPHIC METHOD FOR DETERMINING α-ACTIVE ELEMENTS IN SOLUTIONS. M. Nicolae, Inst. of Nuclear Physics, Bucharest Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz. Studii cercetări fiz., 12: No. 1, 9-20(1961). (In Rumanian)

A nuclear emulsion method based on the number of α-particle trajectories recorded per unit of surface was used for determining α-active elements in a solution. The method, applied in determining Th^{232} and U^{238}, proved more efficient than chemical methods and about 20 times more sensitive than radiometric methods using G-M counters. The sensitivity of the method is 4×10^{-6} g U/ml of solution and 1.5×10^{-12} mc. The method is recommended for determining concentrations of thorium and uranium in ores, water basins, and coal ash. (R.V.J.)

30591 SPECTROGRAPHIC DETERMINATION OF INDIUM IN BY-PRODUCTS OF ZINC METALLURGY. Maria Petrescu and Venera Trita. Acad. rep. populare Romîne, Studii cercetări met., 6: 51-66(1961). (In Rumanian)

Two methods are presented for the spectrographic determination of indium. The methods were refined during investigations to discover indigenous primary sources of indium and during extraction tests on indium. The first method is for determination in metallic lead. It is based on spectra excitation in condensed spark regime (Q24 spectrograph and Feussner spark generator). The limits detectable with this method are 0.006 to 0.1% In. The second method uses In in solution and utilizes perforated electrodes. The spectra are excited in condensed spark regime. The detection limits are 0.0016 to 0.2% In. (tr-auth)

30592 ELECTROANALYTICAL TECHNIQUES IN MOLTEN LITHIUM SULFATE–POTASSIUM SULFATE EUTECTIC. C. H. Liu (Brookhaven National Lab., Upton, N. Y.). Anal. Chem., 33: 1477-9(Oct. 1961). (BNL-5581)

Three electroanalytical techniques for the determination of metal ions in molten lithium sulfate–potassium sulfate at 625° C were examined. Coulometric titration with a potentiometric end point and chronopotentiometry with a solid electrode gave satisfactory results for the determination of copper(I), whereas determinations by direct potentiometry lacked precision. The chronopotentiometric technique involving the reduction of copper(I) to metallic copper gave much better results than the anodic process where copper(I) was oxidized to copper(II). (auth)

30593 INCREMENTAL APPROACH TO DERIVATIVE POLAROGRAPHY. Clemens Auerbach, H. L. Finston, George Kissel, and Joseph Glickstein (Brookhaven National Lab., Upton, N. Y.). Anal. Chem., 33: 1480-4(Oct. 1961). (BNL-5383)

A new approach to direct current polarography is described, which provides an incremental approximation to the derivative current-voltage curve. Incremental polarograms are determined by a sequence of automatic operations. Instrumentation of relatively simple design was built, with extensive use of plug-in amplifiers. Provision is made for simultaneous or separate readout of both current increments and instantaneous currents. Equations were derived which demonstrate close agreement between incremental and conventional derivative polarography. The high resolution inherent in derivative methods is fully realized. Although the charging current response is lower than in conventional polarography, it remains the major factor in limiting sensitivity. Thallium, cadmium, and indium were determined down to concentrations of 2×10^{-6} N with a precision of 3% or better. (auth)

30594 DETERMINATION OF URANIUM IN THE PRESENCE OF MOLYBDENUM BY CONTROLLED-POTENTIAL COULOMETRIC TITRATION. H. E. Zittel, Louise B. Dunlap, and P. F. Thomason (Oak Ridge National Lab., Tenn.). Anal. Chem., 33: 1491-3(Oct. 1961).

A coulometric method for the determination of uranium

(VI) in the presence of molybdenum was developed. Uranium (VI) is titrated coulometrically in a solution of sodium tripolyphosphate and sodium sulfate (pH 7.5 to 9.5) at a potential of −1.40 volts vs. the SCE. Molybdenum(VI) does not interfere when the molybdenum-to-uranium weight ratio does not exceed 1:7. In the range from 1 to 5 mg of uranium titrated, the error of the method is about ±1%. Various possible interferences were studied; most of the interferences can be eliminated easily. The method is relatively simple and rapid. (auth)

30595 STEPWISE TITRATION OF IRON(III) AND IRON(II) WITH EDTA AND FERRICYANIDE. THE SQUARE WAVE TITRIMETRIC END POINT. Larry C. Hall and David A. Flanigan (Vanderbilt Univ., Nashville). Anal. Chem., 33: 1495-8(Oct. 1961).

Mixtures of Fe(III) and Fe(II) in the ratios of 1:1, 5:1, and 1:5 and varying from 0.00125 to 0.00625M were titrated, giving a standard deviation of 0.04 to 0.10 ml and a relative accuracy of 0.94 to 0.12%. Iron(III) was first titrated with EDTA at pH 4.7 to 5.0. Excess EDTA was added, the pH was raised to 6.7 to 7.2, and Fe(II)−EDTA was titrated with ferricyanide. The slope of current-voltage polarization curves at the null potential was used for end point detection. The square wave technique was used to measure the slope. (auth)

30596 SEPARATION OF URANIUM BY REVERSED-PHASE PARTITION CHROMATOGRAPHY ON A KEL-F COLUMN. A. G. Hamlin, B. J. Roberts, W. Loughlin, and S. G. Walker (United Kingdom Atomic Energy Authority, Capenhurst Works, Ches., Eng.). Anal. Chem., 33: 1547-52(Oct. 1961).

Reversed-phase partition chromatography is shown to be a convenient and effective method for the quantitative recovery of microgram to gram quantities of uranium from highly impure solutions of unknown composition. The uranium is obtained in a form suitable for determination by a volumetric, colorimetric, or α-counting technique. Uranium is retained by a column of Kel-F supporting tri-n-butyl phosphate. Impurities are eluted with 5.5M nitric acid, and the uranium is eluted with water. Thorium(IV), plutonium (IV), and cerium(IV) interfere, but interference by cerium can be avoided by reduction to cerium(III) prior to separation. Recovery of uranium is better than 99%. The method can be adapted to the separation of uranium and plutonium. (auth)

30597 TRANSMITTANCE SPECTRA OF COLOR FILTERS. Claude W. Sill (U. S. Atomic Energy Commission, Health and Safety Div., Idaho Falls, Idaho). Anal. Chem., 33: 1584-7(Oct. 1961).

While investigating the effects of sensitivity, linearity, and selectivity of the procedure several fluorometric methods transmittance spectra were obtained of 55 glass and 35 gelatin color filters individually and of 98 two-filter combinations of the glass filters. As many spectra as practicable were recorded on the same chart to facilitate intercomparison. After having determined the absorption and emission spectra of the fluorescent species, selection of the optimum combination of filters for isolation of both the exciting radiation and the emitted fluorescence can be made quickly and simply from the transmittance spectra of the filters presented. (auth)

30598 ACTIVATION ANALYSIS OF TANTALUM IN A NIOBIUM MATRIX. Gilbert Halverson and Albert Shtasel (Fansteel Metallurgical Corp., North Chicago, Ill.). Anal. Chem., 33: 1627-8(Oct. 1961).

The method was developed as an independent check on the results obtained for the determination of small amounts of Ta in Nb by x-ray fluorescence and emission spectroscopy. The method utilizes beta counting of a sample prepared by evaporating a solution in a counting cup. This technique improves the sensitivity over other activation methods dependent upon counting the gamma activity of solids. (auth)

30599 THE EFFECT OF FOREIGN IONS ON THE SPECTROPHOTOMETRIC DETERMINATION OF BORON WITH 1,1′-DIANTHRIMIDE. F. J. Langmyhr and O. B. Skaar (Univ. of Oslo, Blindern, Norway). Anal. Chim. Acta, 25: 262-70(Sept. 1961). (In English)

The effects of about 40 inorganic ions and reducing and oxidizing agents on the determination of boron with 1,1′-dianthrimide were studied spectrophotometrically. The separate foreign ions were added both to solutions containing boron and 1,1′-dianthrimide and to solutions containing only 1,1′-dianthrimide. From the two series of extinction measurements conclusions were drawn as to the type of interference present. With the use of hydrazine sulphate as reducing agent, the only ions interfering were: germanium (IV), tellurium(IV), cobalt(II), nickel(II), copper(II), chromium(III), bromide, iodide, fluoride, vanadate and high concentrations of orthophosphate. A new method of indicating spectrophotometric interference was introduced. (auth)

30600 A RAPID METHOD FOR DETERMINING INDIUM BY NEUTRON ACTIVATION. T. B. Pierce and P. F. Peck (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Analyst, 86: 580-4(Sept. 1961).

A method is described for determining indium in complex mixtures by neutron-activation analysis. The indium is rapidly isolated from other active components by passage through a column consisting of dithizone and an organic solvent retained on cellulose acetate. By this means, the high potential sensitivity afforded by the measurement of the 54-minute In^{116} nuclide can be conveniently exploited. (auth)

30601 THE DETERMINATION OF FLUORINE IN DEPOSIT-GAUGE SAMPLES. P. G. Jeffery and D. Williams (Warren Spring Lab., Stevenage, Herts, Eng.). Analyst, 86: 590-7(Sept. 1961).

The reaction between fluorine, cerium, and alizarin complexone is used for determining fluorine in samples from deposit gauges. Prior separation from interfering elements is achieved by means of a column of cation-exchange resin and also by distillation from perchloric acid solution. The results obtained by these two methods agree well with those found by a method involving distillation from perchloric acid and subsequent titration with thorium nitrate solution (alizarin red S as indicator).

30602 AN IMPROVED METHOD FOR DETERMINING ^{90}Sr IN RAIN WATER. R. G. D. Osmond, C. Healy, and G. F. Marshall (United Kingdom Atomic Energy Authority, Woolwich Outstation, Woolwich, Eng.). Analyst, 86: 616-18(Sept. 1961).

Two methods for the determination are described. In the first method, the sample of rain water is evaporated to a small volume in the presence of nitric acid and Sr, Ba, Ce, Cs, and Y carriers. Insoluble hydroxides and carbonates are precipitated by adding solutions of sodium hydroxide and sodium carbonate. An yttrium oxide source is prepared, and the decay of the beta activity is recorded both directly and also with an aluminum absorber (25 mg per sq cm) placed between the sample and the counting-tube window. After allowance is made for the chemical yield of yttrium, the calculated rate of disintegration is equal to that of Sr^{90} in the sample. This method is applicable to

samples containing debris originating only from old nuclear test explosions when the activity from short-lived rare earth fission products is negligible. In the second method, some modification is made for samples that contain significant amounts of short-lived rare earth fission products. These direct approaches permit a result for Sr^{90} to be obtained within approximately half the usual time, with no additional effort. (P.C.H.)

30603 COULOMETRIC TITRATION OF NIOBIUM WITH EXTERNALLY GENERATED MANGANESE(III) ION. Shigetaka Suzuki (Tokyo Metropolitan Univ.). Bunseki Kagaku, 10: 728-32(July 1961). (In Japanese)

The investigation was undertaken to develop coulometric titration with externally generated reagents. The determination of niobium with externally generated manganese(III) ion was studied. An electrolyte composed of 0.4N manganese sulfate and 6N sulfuric acid was introduced into an external generating cell, manganese(III) ion being generated with constant current electrolysis. Niobium, reduced with zinc amalgam, was titrated using potentiometric end point detection. The maximum anodic current density was 5 mamp/cm. Micro quantities of niobium from about 0.3 to 2 mg were determined with an average error of about 1%. The method was applied to the determination of niobium in stainless steel. (auth)

30604 STUDIES ON THE DETERMINATION OF TRACE OF ELEMENTS IN IRON AND STEELS. VI. SPECTROPHOTOMETRIC DETERMINATION OF BERYLLIUM IN IRON AND STEEL USING ACETYL ACETONATE EXTRACTION METHOD. Shizuya Maekawa and Yoshio Yoneyama (Japan Steel Works, Ltd., Muroran). Bunseki Kagaku, 10: 732-6(July 1961). (In Japanese)

The extraction of beryllium–acetylacetone complex with chloroform and the spectrophotometric determination of beryllium was applied for the iron and steel analysis. 0.25 g of sample is decomposed in 10 ml of perchloric acid, and when chromium content exceeds 3% most of it is evaporated as chromyl chloride. The solution is diluted exactly to 250 ml and an aliquot (2 to 10 ml) is taken. 5 ml of citric acid solution (20%) and 10 ml of ethylenediaminetetraacetic acid (5%) are added to mask iron and other elements. 1.0 ml of acetylacetone aqueous solution (5%) and 10 ml of sodium chloride (20%) are added, and pH is adjusted to 7.0 ~ 7.5 by the use of 1N sodium hydroxide. Beryllium complex is extracted with 10 ml of chloroform. The organic phase is backwashed with 50 ml of 0.1N sodium hydroxide to remove free acetylacetone, and the backwashing is done again. The light absorption is measured at 295 mμ by comparison with chloroform. Where the aluminum content exceeds 0.5%, beryllium is read a little higher, as a bit of aluminum probably forms an acetylacetonate and is extracted with chloroform. (auth)

30605 STUDIES ON THE DETERMINATION OF TRACE OF ELEMENTS IN IRON AND STEELS. VII. SPECTROPHOTOMETRIC DETERMINATION OF MICRO AMOUNTS OF CADMIUM IN CAST IRON. Shizuya Maekawa and Yoshio Yoneyama (Japan Steel Works, Ltd., Muroran). Bunseki Kagaku, 10: 736-40(July 1961). (In Japanese)

An absorption photometric method for the determination of cadmium in cast iron by extraction as a dithizonate is described. The sample is decomposed by perchloric acid. After an addition of citric acid, ammonium hydroxide is added up to pH 9. Cadmium is extracted together with copper and nickel by dithizone–chloroform solution. From the extract, cadmium and zinc are stripped into 0.1N hydrochloric acid. In order to remove zinc, cadmium is extracted with sodium diethyldithiocarbamate–carbon tetrachloride from a solution (pH 10.5) containing hydroxylamine hydrochloride, sodium potassium tartrate, potassium cyanide, and formalin. The addition of a small amount (0.5 mg) of bismuth improves the recovery of cadmium. The extract is then evaporated to dryness and decomposed with nitric and hydrochloric acids. Cadmium is extracted with dithizone–chloroform from sodium hydroxide solution which contains hydroxylamine hydrochloride, sodium potassium tartrate, and a small amount of potassium cyanide, and the absorbance is measured at 510 mμ. The loss of cadmium was very little, and satisfactory results were obtained. (auth)

30606 A NEW METHOD FOR SPECTROPHOTOMETRIC DETERMINATION OF BORON WITH RUTIN. Kazuo Hiiro (Osaka Industrial Research Inst.). Bunseki Kagaku, 10: 741-6(July 1961). (In Japanese)

A new photometric method for determining boron with rutin as a color reagent is proposed. The sample solution is evaporated with proper amounts of hydrochloric and oxalic acids and rutin reagent solutions. Then, the dried residue is dissolved with acetone, and absorbance of the solution thus obtained is measured at 440 mμ. Effects of the concentrations of hydrochloric and oxalic acids and of rutin, and drying conditions such as temperature, duration of heating, and vessels for evaporation are examined, respectively. It is found that Beer's law is obeyed over a range of 0.00–0.30 ppm of boron. The proposed new photometric method is applied to the determination of trace amounts of boron in samples of reactor graphite. (auth)

30607 DETERMINATION OF TRACE IMPURITIES IN URANIUM METAL. IX. COMBUSTION-GRAVIMETRIC DETERMINATION OF TRACE OF CARBON IN URANIUM METAL. Iwao Fujishima and Tsugio Takeuchi (Nagoya Univ., Japan). Bunseki Kagaku, 10: 747-50(July 1961). (In Japanese)

The method is suitable for total carbon determination in uranium metal, the carbon content of which is from 10 to 1000 γ. 1 g or less of the sample of uranium metal, taken in a fused silica boat, is burned in a purified oxygen stream (60 ml per minute) in a furnace. The issuing gases and oxygen used for flushing are passed in turn through 10% platinum–asbestos, silver gauze, anhydrous magnesium perchlorate, and finally 2 absorbing tubes, each of which contains solid sodium hydroxide and anhydrous magnesium perchlorate. The precision attained was estimated to be 1.6, 2.6, and 3.2% in terms of standard deviation, based on 780, 380, and 94 γ of carbon, respectively. Analytical results for 5 uranium metal specimens are given. (auth)

30608 SPECTROGRAPHIC DETERMINATION OF EXTREMELY LOW CONCENTRATIONS OF BORON IN URANIUM. Tokunosuke Nakajima, Masao Takahashi, and Yaeko Uruno (Japan Atomic Energy Research Inst., Tokyo). Bunseki Kagaku, 10: 763-9(July 1961). (In Japanese)

Basic experiments were made on carrier materials, mixing ratio of sample to the carrier material, discharge current, exposure period, and atmosphere of electrode gap. As a result, it was found that as little as 0.02 ppm of boron in uranium can be determined without chemical concentration. (auth)

30609 DETERMINATION OF URANIUM(VI) WITH HEXAMMINECOBALT(III) CHLORIDE. Kaoru Ueno and Ichiro Turumaki (Japan Atomic Energy Research Inst., Tokyo). J. At. Energy Soc. Japan, 3: 598-601(Aug. 1961). (In Japanese)

The indirect colorimetric determination of 0.025 ~ 10.0 mg U(VI) was made by two different methods: measurement of absorbance at 473 mμ for hexamminecobalt(III) ion, and

the colorimetric determination of Co(II) ion contained in the precipitate. For hexamminecobalt(III) photometry, disturbance of the method caused by the presence of Ca, Ni, Co, Cu, Pb, Cd, Fe, Bi, and Th were studied. Futhermore, a radiometric determination was devised for the estimation of 0.005 ~ 0.500 mg U(VI) with the Co^{60} tagged precipitant. (auth)

30610 SIMULTANEOUS DETERMINATION OF NIOBIUM AND TANTALUM IN STEEL, FERRO-NIOBIUM AND PERMANENT MAGNET ALLOY. L. Kidman and G. White (English Steel Corp., Ltd., Sheffield, Eng.). Metallurgia, 64: 153-6(Sept. 1961).

A simple procedure is described for the simultaneous determination of niobium and tantalum in steels, ferro-niobium, and permanent magnet alloy. The method depends on the solvent extraction of tantalum from the mixed oxides of tantalum and niobium obtained by precipitation with phenylarsonic acid from dilute hydrochloric acid solution. Trace amounts of tantalum are measured colorimetrically; niobium and amounts of tantalum greater than 0.1% are determined gravimetrically. (auth)

30611 FAST EXTRACTION–PHOTOMETRIC DETERMINATION OF U ARSENAZO III REAGENT. P. N. Palei, A. A. Nemodruk, and A. V. Davydov. Radiokhimiya, 3: 181-6(1961). (In Russian)

A fast photometric–extraction method of uranium determination in ores, minerals, and solutions was achieved. Uranium was extracted 20% tributyl phosphate in carbon tetrachloride, using ammonium nitrate as a salting-out agent and complexone III for retaining interfering elements in the aqueous phase. Uranium was re-extracted with arsenazo III and determined photometrically. The method is suitable for concentrations of 0.0002γ/ml and over. (R.V.J.)

30612 ANALYTICAL CHEMISTRY OF THORIUM. III. PHOTOMETRIC DETERMINATION OF THORIUM ARSENAZO III IN ORES. V. F. Luk'yanov, I. V. Nickol'skaya, and E. S. Kozlova. Radiokhimiya, 3: 239-40(1961). (In Russian)

A method is offered for determining 0.01 to 0.001% thorium in phosphorites, silicates, fluorapatites, and other materials by separation followed by precipitation on potassium oxalate. (R.V.J.)

30613 DIAMMONIUM-5,5′-INDIGO DISULPHONATE AS AN ANALYTICAL REAGENT. GRAVIMETRIC DETERMINATION OF THORIUM AND $CERIUM^{III}$ AND THEIR SEPARATION FROM $URANIUM^{VI}$. B. D. Jain and J. J. Singh (Univ. of Delhi). Talanta, 8: 648-52(Sept. 1961). (In English)

The use of diammonium-5,5′-indigo disulphonate for the gravimetric determination of thorium and cerium(III), and their separation from uranium(VI) was investigated. Thorium and cerium(III) are quantitatively precipitated within the pH range of 3.5 to 4.5 and 3.0 to 6.0 respectively, while uranium does not form any insoluble complex at this pH. The precipitate obtained in each case is ignited to the corresponding oxide and weighed. (auth)

30614 GRAVIMETRIC DETERMINATION OF TUNGSTEN BY HOMOGENEOUS PRECIPITATION. R. Dams and J. Hoste (Universiteit, Ghent). Talanta, 8: 664-72 (Sept. 1961). (In English)

A homogeneous precipitation method was developed for the gravimetric determination of tungsten, by thermal decomposition of soluble peroxytungstate from a nitric acid–hydrogen peroxide solution. It appears that in all cases, especially for small concentrations, the tungsten recovery is superior to the classical techniques using cinchonine or β-naphthoquinoline. Furthermore, co-precipitation of molybdenum and vanadium are reduced to a considerable extent. The study of the co-precipitation process shows that the distribution coefficients follow a linear pattern for both contaminants. The method was tested with good results on a number of standard tungsten alloy steels, corrections for incomplete precipitation and co-precipitation being applied on the basis of the experimentally found values. (auth)

30615 ANALYTICAL USE OF ARSENAZO. III. DETERMINATION OF THORIUM, ZIRCONIUM, URANIUM AND RARE EARTH ELEMENTS. S. B. Savvin (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, Moscow). Talanta, 8: 673-85(Sept. 1961). (In English)

The reagent arsenazo III (1,8-dihydroxynaphthalene-3,6-disulphonic acid-2,7-bis[(azo-2)-phenylarsonic acid]) gave marked color reactions with a number of elements. Anions were found to affect the reaction only to a slight degree and it is possible to work at low pH values; the reaction is very sensitive and the compound was thus used for the photometric determination of Th, Zr, Hf, U, rare earths, and some other elements. The method is most selective for Th, Zr, and U(IV). Materials containing these elements can be analyzed directly, in the solutions formed after dissolving the sample, without separation of the stable elements. (auth)

30616 CHELATOMETRIC DETERMINATION OF CAESIUM. Arthur de Sousa (Univ. of Lisbon). Talanta, 8: 686-8(Sept. 1961). (In English)

An indirect chelatometric method for the determination of cesium is described. Cesium is precipitated as perchlorate according to the classical procedure and the precipitate is heated with ammonium chloride to reduce the perchlorate to chloride. Cesium chloride is dissolved in water and the chloride is precipitated as silver chloride. This precipitate is dissolved in an ammoniacal solution of potassium nickelicyanide. Silver displaces nickel in the complex and the freed nickel is titrated with EDTA. Cesium is obtained indirectly by multiplying the quantity of EDTA solution by a factor. The results are very satisfactory and the method is as rapid as the gravimetric procedure, with the advantage of avoiding the tedious drying and weighing of the perchlorate precipitate. (auth)

30617 DETERMINATION OF THE Kr^{85} CONTENT OF THE AIR. O. Griesser and A. Sittkus (Max-Planck-Institut für Kernphysik, Heidelberg, Ger.). Z. Naturforsch., 16a: 620-1(June 1961). (In German)

During 1959 and 1960 seven samples of atmospheric krypton were examined for their content of radioactivity. The Kr^{85} content increased from the middle of 1959 to the end of 1960 from 3.3 to 4.5×10^{-12} c/cm^3 Kr. This corresponds to a Kr^{85} activity of the atmosphere of 3.8 and 5.1×10^{-18} c/cm^3 air respectively. These data are discussed in connection with the production of the isotope by nuclear fission. It is shown that the main part presumably originates from reactor stations. (auth)

30618 DETERMINATION OF MICROQUANTITIES OF SULFUR IN TITANIUM AND ZIRCONIUM BY IODINEAZIDE REACTION. L. V. Markova (Inst. of General and Inorganic Chemistry, Academy of Sciences, Ukrainian SSR). Zavodskaya Lab., 27: 379-81(1961). (In Russian)

Microquantities of sulfur were determined in Ti and Zr by photometric analysis. The catalytic iodineazide reaction and a highly-sensitive standard solution scale were used. The determination takes 2.5 to 3 hours and is accurate to within 10%. (R.V.J.)

30619 DETERMINATION OF URANIUM IN ROCKS AND OPEN WATERS. V. B. Spivakovskii, V. A. Zimina, and L. S. Gavrilyuk (Kiev State Univ.). Zavodskaya Lab., 27: 390-1(1961). (In Russian)

A method is suggested for determining uranium traces. A suspended specimen is decomposed by nitric acid, and the uranyl nitrate is extracted with ether. Sodium fluoride is added to the extract, and the precipitated residue is melted. The uranium content is determined by bead luminescence (concentrations < 0.001%). At higher concentrations the ether solution is treated with sulfuric acid and the uranium is determined polarographically. (tr-auth)

30620 COLORIMETRIC DETERMINATION OF ZIRCONIUM IN ALLOYS. V. G. Goryushina, E. V. Romanova, and T. A. Archakova (State Scientific-Research and Project Inst. of Rare Metal Industry, USSR). Zavodskaya Lab., 27: 795-7(1961). (In Russian)

A comparative evaluation is made of three colorimetric methods for Zr determination: with violet pyrocatechin, orange xylenol, and arsenazo. Arsenazo III proved to be the most universal and can be used for determining zirconium in the presence of Ti, Fe, Cu, V, Al, Mg, and others. (R.V.J.)

30621 PHOTOMETRIC DETERMINATION OF Zr IN Hf BY ARSENAZO III. S. V. Elinson and N. A. Mirzoyan. Zavodskaya Lab., 27: 798-801(1961). (In Russian)

Properties of colored Hf and Zr complexes with arsenazo III and their reactions to increased acidity are analyzed. Small concentrations of Zr (0.2% and over) may be determined in metallic Hf on the basis that the optical density of Hf complexes with arsenazo III rapidly diminishes at 4N HCl while the optical density of Zr complexes does not. (R.V.J.)

30622 DETERMINATION OF BORON IN METALLIC TITANIUM AND ZIRCONIUM. P. V. Marchenko (Inst. of General and Inorganic Chemistry, Academy of Sciences, Ukrainian SSR). Zavodskaya Lab., 27: 801-2(1961). (In Russian)

The determination is based on the formation and extraction of complex tetrafluoboric acid. The method is capable of determining 10^{-3}% B in titanium and 5×10^{-4}% B in zirconium. Ammonium fluoride is used as complexing agent. (R.V.J.)

General Inorganic and Physical Chemistry

30623 (AERE-M-813) THE PREPARATION AND PURIFICATION OF SOLUTIONS OF UCl_3 IN LiCl–KCl EUTECTIC ON A 1.5 kgm SCALE. B. A. Partridge, R. J. Moulton, and J. R. Morgan (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Aug. 1961. 20p.

The preparation of high-purity 30 wt % uranium trichloride in LiCl–KCl eutectic at 500°C is described. Handling techniques have been devised which are suitable for large-scale use. (auth)

30624 (IA-627) URANIUM ACTIVITIES CALCULATED FROM THE U–Fe AND U–Al PHASE DIAGRAMS. A. J. Jacobs (Israel. Atomic Energy Commission, Tel-Aviv). June 1961. 12p.

Uranium activities and activity coefficients were calculated in the U–Fe and U–Al systems. (L.T.W.)

30625 (TID-13903) TESTS OF A PLATINIC ACID–THORIUM HYDROXIDE CATALYST FOR HYDROGEN–OXYGEN RECOMBINATION. Technical Report No. 11. C. Keith Hanson, Ralph M. Horton, and Milton E. Wadsworth (Utah. Univ., Salt Lake City. Inst. of Metals and Explosives Research). Jan. 31, 1961. for Oak Ridge National Lab. Contract W-7405-Eng-26, Subcontract 1075. 14p.

Tests were run using a platinic acid and a platinic acid-thorium hydroxide catalyst, both with and without inert thoria present. The catalysts without inert thoria were observed to deteriorate in activity with repeated runs. Those with inert thoria present increased in activity with repeated runs indicating platinum redistribution onto the inert thoria. The platinic acid-thorium hydroxide catalyst with thoria was the most active, reaching a Catalytic Performance Index (CPI) plateau value of about 6200 watts/ml. (auth)

30626 (UCRL-9694) TABLE OF VIBRATIONAL FORCE CONSTANTS. Dudley R. Herschbach (California. Univ., Berkeley. Dept. of Chemistry; California. Univ., Berkeley. Lawrence Radiation Lab.). and Victor W. Laurie (Stanford Univ., Calif.). July 1961. Contract W-7405-eng-48. 45p.

Tabulations are included for: vibrational and rotational parameters for diatomic molecules; quadratic, cubic, and quartic vibrational force constants of diatomic molecules; parameters for empirical functions relating force constants to bond length; and cubic force constants for bond stretching in polyatomic molecules. (B.O.G.)

30627 (AEC-tr-4830) RESEARCH ON THE STATE OF Pu(IV) IN DILUTE SOLUTIONS OF NITRIC ACID. B. I. Grebenshchikova (Grebenshchikoba) and Yu. P. Davydov (Davidov). Translated from Radiokhimiya, 3: 155-64(1961). 14p.

The ionic, colloidal, and pseudocolloidal states of Pu(IV) in concentrations of $\sim 10^{-8}$ M were studied in pure nitric acid solutions. Results of studies of adsorption on glass, ultrafiltration, centrifugation, and migration in electric field indicated that in 6.8×10^{-10} M concentration Pu(IV) is ionic at pH = 2.8; pseudo-colloidal at pH = 2.8 to 7.5, and colloidal at pH = 7.5 to 12.0. (R.V.J.)

30628 (AEC-tr-4835) SOLUBILITY ISOTHERM OF THE SYSTEM $UO_2(NO_3)_2$–$Be(NO_3)_2$–H_2O AT 25°. M. A. Yakimov and H. F. Nosova. Translated by K. S. Warren (Oak Ridge National Lab., Tenn.) from Zhur. Neorg. Khim., 6: 208-11(1961). 4p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 14286.

30629 (NP-tr-768) POLARIZATION OF THE ELECTRONIC BANDS OF AROMATIC COMPOUNDS. III. QUINOLINE, ISOQUINOLINE, INDOLE. Herbert Zimmermann and Norman Joop. Translated by R. E. Whan and G. A. Crosby (Univ. of New Mexico, Albuquerque) from Z. Elektrochem., 65: No. 1, 61-5(1961). 8p.

The absorption, fluorescence, and polarization spectra of quinoline, quinoline perchlorate, isoquinoline, isoquinoline perchlorate, and indole were measured in the near ultraviolet and were compared with the spectrum of naphthalene. The absorption spectra of all compounds belong to the same type. Isoquinoline possesses, besides the absorption bands common to all compounds, two additional electronic transitions. It seems probable that for indole the fluorescence occurs from two closely adjacent electronic states. (auth)

30630 (NP-tr-770) POLARIZATION OF THE ELECTRONIC BANDS OF AROMATIC COMPOUNDS. I. NAPHTHALENE, ANTHRACENE, TETRACENE. Herbert

Zimmermann and Hermann Joop. Translated by R. Nutt and G. A. Crosby (Univ. of New Mexico, Albuquerque) from Z. Elektrochem., 64: 1215-19(1960). 8p.

The relative polarization of electron bands of naphthalene, anthracene, and tetracene were determined from the fluorescence polarization of the solutions and were compared with the theory. The vibrational structure of electronic transitions was detected by the polarization spectrum. For anthracene, series-like formulas were given for the ^1L_a band. (auth)

30631 (NP-tr-772) ULTRAVIOLET SPECTROSCOPY WITH POLARIZED LIGHT. Friedrich Dorr and Manfred Held. Translated by R. E. Whan and G. A. Crosby (Univ. of New Mexico, Albuquerque) from Angew. Chem., 72: 287-94(1960). 18p.

Absorption spectra in the ultraviolet and visible ranges are important tools for the clarification of the electronic structure of molecules. The assignment of an absorption band is considerably facilitated by knowing, besides the frequency and the intensity of the band, the spatial orientation of the electronic oscillators in the molecule. The methods of determining the orientations are reviewed, and descriptions are given of the methods of measuring and interpreting the degree of polarization of fluorescence on excitation with polarized light in different absorption bands. (auth)

30632 (NP-tr-773) POLARIZATION OF THE ELECTRONIC BANDS OF AROMATIC COMPOUNDS. IV. PHENANTHRENE, CHRYSENE, TETRAPHENE. Herbert Zimmermann and Normann Joop. Translated from R. E. Whan and G. A. Crosby (Univ. of New Mexico. Albuquerque) from Z. Elektrochem., 65: 66-70(1961). 9p.

The absorption, fluorescence, and polarization spectra of phenanthrene, chrysene, and tetraphene were measured. The polarization spectra were compared with the results of quantum mechanical calculations. The ^1L_b transitions of phenanthrene and chrysene consist of differently polarized series of vibronic bands for which series formulas have been developed. (auth)

30633 A SURVEY OF RESEARCH ON THE TRANSURANIC ELEMENTS. M. B. Waldron (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Contemporary Phys., 2: 385-402(June 1961).

The history, behavior, production, properties, and experimental background of the transuranic elements are reviewed. For comparison, the properties of the lanthanide elements and the remaining actinide elements are discussed and presented. (N.W.R.)

30634 APPLICATION OF STABLE ISOTOPES IN INORGANIC CHEMISTRY AND CATALYSIS RESEARCH. I. Maass (Institut für Physikalische Stofftrennung, Leipzig). Isotopentechnik, 1: 187-9(May 1961). (In German)

The utilization of the stable isotopes D, N^{15}, and O^{18} in inorganic chemistry and catalytic research is shown by examples. (tr-auth)

30635 ALLOWANCE FOR ISOTOPE EFFECTS IN WORK WITH STABLE ISOTOPES IN ORGANIC CHEMISTRY. P. Krumbiegel (Institut für Physikalische Stofftrennung, Leipzig). Isotopentechnik, 1: 190-2(May 1961). (In German)

The various types of isotope effects are described, and some of the more important ones in organic chemistry are shown by examples. The significance of the isotope effect is indicated from these examples. (tr-auth)

30636 PRODUCTION AND DIELECTRIC PROPERTIES OF SOLID SOLUTION MONOCRYSTALS $Pb(TiO_3-ZrO_3)$, LEAD METANIOBATES AND SOLID SOLUTIONS OF LEAD METANIOBATES AND TITANATES. A. L. Khodakov and M. L. Sholokhovich (Rostov-on-Don State Univ., USSR). Izvest. Vysshikh Ucheb. Zavedenii, Fiz., No. 2, 85-91(1961). (In Russian)

Production and dielectric properties of solid solutions of lead metatitanates and metazirconates, monocrystals of $PbNb_2O_6$, and solid solutions with $PbTiO_3$, are described. The electric conductivity of $Pb(Ti-Zr)O_3$ crystals increased with increased temperature. Small additions of $PbZrO_3$ do not change the dielectric properties of the solution. The conditions were found for $PbNb_2O_6$ monocrystal transitions from nonseignettoelectric to seignettoelectric. (tr-auth)

30637 MECHANISM OF ELECTRICAL CONDUCTIVITY IN FUSED SALTS. Frederick R. Duke and George Victor (Ames Lab., Ames, Iowa). J. Am. Chem. Soc., 83: 3337 (1961). (IS-306)

Mixtures of lithium nitrate and potassium nitrate were placed in the anode compartment and pure sodium nitrate in the cathode compartment of a U-shaped cell, the compartments being separated by ultrafine Pyrex or quartz porous plate. Electrolysis was allowed to proceed and the total number of cations and the ratio of Li:K passing from anode to cathode compartment were measured. The results show that within experimental error the ions move at the same rate in all mixtures. The transport number is indicative of which ion the mixture resembles most. The transport numbers of the cations in pure potassium nitrate and lithium nitrate are 0.60 and 0.84, respectively. The ionic conductivity in these fused salts is probably a polyorder process (ions moving in groups or by chain mechanism, such as a charged hole moving through many ionic diameters with a single activation step). (N.W.R.)

30638 ELECTRONEGATIVITY. Raymond P. Iczkowski and John L. Margrave (Univ. of Wisconsin, Madison). J. Am. Chem. Soc., 83: 3547-51(Sept. 5, 1961).

The energies of positive and negative ions relative to the neutral atoms are conveniently and accurately expressed for a given atom by a power series in N = n − Z, where n = the number of electrons around the nucleus in a given ionization state and Z = the atomic number of the nucleus. For a neutral atom the electronegativity is defined as $\chi = (-dE/dN)_{N=0}$ where dE is the energy change which accompanies the change in charge dN and should be expressed in the units energy per electron. Similarly the value of $(-dE/dN)_{N=-1}$ represents the electronegativity of the singly charged positive ion. The E(N) curve exhibits a discontinuity in slope at N values where there is a transition from one type of atomic orbital to another. If only the first ionization potential and the first electron affinity are known for a given species, $\chi = (-dE/dN)_{N=0}$ is equivalent to the well-known Mulliken relationship that electronegativity is equal to the average of the ionization potential and the electron affinity. (auth)

30639 REACTIONS OF GASEOUS IONS. IX. CHARGE EXCHANGE REACTIONS OF RARE GAS IONS WITH ETHYLENE. J. L. Franklin and F. H. Field (Humble Oil and Refining Co., Baytown, Tex.). J. Am. Chem. Soc., 83: 3555-9(Sept. 5, 1961).

Using a mass spectrometer ion source as a reactor, ions of all of the rare gases were shown to undergo charge exchange reactions with ethylene. The rates of these reactions are in the order of 10^{-10} to 10^{-9} cc molecule^{-1} sec^{-1} and thus are similar to those of other ion–molecule reactions. Xenon and argon ions, respectively, produce $C_2H_4^+$ and $C_2H_3^+$ predominantly. Krypton ions produce $C_2H_4^+$, $C_2H_3^+$, and $C_2H_2^+$ in approximately the ratio 1:2:1. Helium

and neon ions react somewhat more slowly than the others and produce CH_2^+ predominantly. (auth)

30640 THE ROLE OF NON-BONDED REPULSIONS IN SECONDARY ISOTOPE EFFECTS. I. ALPHA AND BETA SUBSTITUTION EFFECTS. L. S. Bartell (Iowa State Univ. of Science and Tech., Ames). J. Am. Chem. Soc., 83: 3567-71(Sept. 5, 1961).

Beta deuterium isotope effects in reactions involving carbonium ions were attributed almost universally to hyperconjugative weakening of C–H or C–D bonds. In view of recent calculations which indicate that structural and thermochemical effects in ground states of molecules previously ascribed to hyperconjugation can be correlated semiquantitatively in terms of non-bonded interactions, the non-bonded model is now extended to the treatment of isotope effects. Its basis is that repulsions involving deuterium atoms, when averaged over stretching and bending vibrations, are smaller than those for hydrogen which has a characteristically greater amplitude of vibration. Results are found to be sensitive to assumptions made about molecular structures. Nevertheless, results for several typical reactions strongly indicate that the isotopic differences in relief of non-bonded repulsions experienced by molecules going from crowded tetrahedral configurations to trigonal transition states or products, are quite comparable to the observed isotopic free energy differences. The alpha deuterium isotope effect, previously regarded as unrelated to the beta effect, is found to be accounted for semiquantitatively by the same model. (auth)

30641 MULTILAYER MEMBRANE ELECTRODES. III. ACTIVITY OF ALKALINE EARTH SALTS IN MIXED ELECTROLYTES. Harold Schonhorn and Harry P. Gregor (Polytechnic Inst., Brooklyn). J. Am. Chem. Soc., 83: 3576-9(Sept. 5, 1961).

Multilayer membranes composed of the alkaline earth salts of stearic and hexadecylsulfuric acids act as reversible electrodes to these cationic species only in mixed electrolytic solutions with even large excesses of alkali metal cations when the membrane is maintained at nearly constant volume by the imposition of a high pressure. Mixed electrolytic solutions of calcium or barium chloride with sodium or potassium chloride were studied at ionic strengths from 0.0003 to 1.5; these obeyed Harned's rule with slopes of zero at ionic strengths <0.1, rising to -0.08 at ionic strength 1.5. Thus, thermodynamic activity coefficients of 2–1 electrolytes in mixed solutions with 1–1 salts were measured directly. (auth)

30642 THE INFRARED SPECTRA OF ALKYLLITHIUM COMPOUNDS. Robert West and William Glaze (Univ. of Wisconsin, Madison). J. Am. Chem. Soc., 83: 3580-3 (Sept. 5, 1961).

The infrared spectra of methyllithium, ethyllithium, and phenyllithium were investigated in the region 300–4000 cm^{-1}. Results upon substitution of lithium-6 for lithium-7 and of deuterium for hydrogen in methyllithium show that previous assignments of bands in the 800–1000 cm^{-1} region to carbon–lithium fundamental stretching modes are in error. The only bands found which involve the motion of lithium atoms occur between 350 and 570 cm^{-1}; these appear to represent complex modes of vibration in polymeric species. The bonding in organolithium compounds is discussed in the light of the spectral evidence. (auth)

30643 THE PREPARATION OF ORGANOLITHIUM COMPOUNDS BY THE TRANSMETALATION REACTION. I. VINYLLITHIUM. Dietmar Seyferth and Michael A. Weiner (Massachusetts Inst. of Tech., Cambridge). J. Am. Chem. Soc., 83: 3583-6(Sept. 5, 1961).

The transmetalation reaction occurring between phenyllithium and tetravinyltin (4 : 1 molar ratio) in ether produces vinyllithium in good yield. A similar reaction occurs between n-butyllithium and tetravinyltin in pentane; in this case solid vinyllithium precipitates. Vinyllithium is more stable in ether and tetrahydrofuran solution than are n-butyllithium or phenyllithium. The use of vinyllithium in the preparation of a number of previously known vinyl compounds, as well as of the new $[B(CH=CH_2)_4]^-$ and $[B(CH=CH_2)\ (C_6H_5)_3]^-$ ions, is described. (auth)

30644 HYPOCHROMISM AND OTHER SPECTRAL PROPERTIES OF HELICAL POLYNUCLEOTIDES. William Rhodes (Florida State Univ., Tallahassee). J. Am. Chem. Soc., 83: 3609-17(Sept. 5, 1961).

Exciton interaction in a double-stranded helical polymer, such as a homogeneous polynucleotide, leads to a splitting of each excited electronic energy level of the monomer into two exciton bands of energy levels. Consideration of the selection rules derived from zeroth-order functions shows that for double-stranded polynucleotides $\pi \rightarrow \pi^*$ transitions are allowed to, at most, one exciton level of each band, both polarized perpendicularly to the helix axis; whereas, $n \rightarrow \pi^*$ transitions are allowed only to one level of the upper band, that being polarized parallel to the helix axis. Examination of the spectral properties of the four constituents of deoxyribonucleic acid (DNA) reveals that although exciton bands probably exist in regions of spectral overlap, there should be isolated energy levels lying below the main exciton bands. These levels may act as localized energy traps during excitation propagation through the helix. In order to treat the problem of hypochromism, it is necessary to use first-order functions. An equation is developed which takes into account the effect of exciton interaction and dispersion-force interaction on the oscillator strength of the helix. Application of this equation to a helical, double-stranded polyadenylic acid having the configuration of DNA indicates that perturbation resulting from dispersion-force interaction among the bases can account for the observed hypochromism. (auth)

30645 AQUEOUS ZIRCONIUM COMPLEXES. II. MIXED CHELATES. B. J. Intorre and A. E. Martell (Clark Univ., Worcester, Mass.). J. Am. Chem. Soc., 83: 3618-23 (Sept. 5, 1961).

Zr(IV) chelates in which not all of the coördination sites of the metal are satisfied by a multidentate ligand are found to combine with one or two additional moles of a second multidentate ligand to form more completely coördinated compounds which are more stable than those formed by either ligand alone. Particularly simple and stable are the mixed chelates with one mole of EDTA plus one mole of pyrocatechol-3,5-disulfonate, chromotropic salt, 8-hydroxyquinoline-5-sulfonate, oxalic acid, or acetylacetone; one mole of 1,2-diaminocyclohexanetetraacetic acid plus one mole of pyrocatechol-3,5-disulfonate, oxalic acid, 8-hydroxyquinoline-5-sulfonate, or acetylacetone; one mole of N-hydroxyethylethylenediaminetriacetic acid plus one mole of pyrocatechol-3,5-disulfonate, or 8-hydroxyquinoline-5-sulfonate; and one mole of nitrilotriacetic acid plus two moles of pyrocatechol-3,5-disulfonate. Other combinations yield soluble Zr(IV) chelate systems which are also quite stable but are somewhat less well-defined. (auth)

30646 AN ELECTRON SPIN RESONANCE STUDY OF THE REACTION OF PYRIDINE WITH POTASSIUM: THE FORMATION OF BIPYRIDYL NEGATIVE ION. Raymond L. Ward (Univ. of California, Livermore). J. Am. Chem. Soc., 83: 3623-6(Sept. 5, 1961). (UCRL-6322-T)

An electron spin resonance study of the product of the

reaction of potassium metal with pyridine in 1,2-dimethoxyethane was performed. Deuterated species were synthesized and their negative ions prepared. A comparison of these paramagnetic species with the negative ion of 4,4'-bipyridyl indicates that pyridine undergoes a coupling reaction. Hyperfine coupling constants were determined for all the magnetic nuclei, and the concept of spin density on the nitrogen atom is discussed. (auth)

30647 MOLECULAR REARRANGEMENTS. XVII. THE DEAMINATIONS OF D- AND L-ERYTHRO-1-AMINO-1,2-DIPHENYLPROPANOL-2 AND OF D-2-AMINO-1,1-DIPHENYLPROPANE. Ben M. Benjamin, Pelham Wilder, Jr., and Clair J. Collins (Oak Ridge National Lab., Tenn.). J. Am. Chem. Soc., 83: 3654-62(Sept. 5, 1961).

The radiochemical and stereochemical consequences of the deamination, accompanied by phenyl migration, of D- and L-erythro-1-amino-1,2-diphenyl-(1-phenyl-C^{14})-propanol-2 (IV) were studied. It is established that the major products, α- or β-benzhydryl-phenyl-C^{14} methyl ketone (V) were formed with an average of 73.5% inversion and 26.5% retention of configuration at the migration termini. There was no α-phenylpropiophenone formed, thus establishing that no methyl migration occurred during these rearrangements. These results exclude the intervention of initially formed bridged ion intermediates in the deamination of IV. Similar studies were conducted upon two modifications of stereospecifically phenyl-labeled D-2-amino-1,1-diphenylpropane (VII), which underwent deamination to yield L-(+)-threo-1,2-diphenylpropanol-1 (55%, threo-VIII) and D-(+)-erythro-1,2-diphenylpropanol-1 (11%, erythro-VIII), 6–7% of olefins and 25–27% of materials which were not identified. These results indicate open carbonium ion formation during the deamination of VII, and are best interpreted in terms of ground-state control of the intermediate open ions. The absolute configuration of D-(–)-phenylglycine was confirmed through the series of reactions just discussed by the conversion of (+)-amino-desoxybenzoin to (–)-2-amino-1,1,2-triphenylethanol. The radiochemical results serve to establish the configurations of D-(+)- and L-(–)-2-amino-1,1-diphenylpropane (VII). (auth)

30648 MOLECULAR REARRANGEMENTS. XVIII. THE DEAMINATION OF ERYTHRO- AND THREO-1-AMINO-1-PHENYL-2-p-TOLYL-2-PROPANOL. Ben M. Benjamin and Clair J. Collins (Oak Ridge National Lab., Tenn.). J. Am. Chem. Soc., 83: 3662-8(Sept. 5, 1961).

The deaminations of optically active erythro- and threo-1-amino-1-phenyl-2-p-tolyl-2-propanol (III) were studied. Whereas the erythro isomer yields p-methylbenzhydryl methyl ketone (IV) in which inversion predominates over retention in the ratio of 74 : 26, the threo isomer produces IV in which the ratio of inversion to retention is 43 : 57. These data clearly establish the open carbonium character of the intermediates. The absence of α-phenyl-4'-methylpropiophenone (V) in either deamination product rules out methyl migration during both reactions. (auth)

30649 ELECTROPHILIC SUBSTITUTION AT SATURATED CARBON. XIV. ASYMMETRIC SOLVATION OF CARBANIONS IN STEREOSPECIFIC HYDROGEN–DEUTERIUM EXCHANGE REACTIONS. Donald J. Cram, Charles A. Kingsbury, and Bruce Rickborn (Univ. of California, Los Angeles). J. Am. Chem. Soc., 83: 3688-96 (Sept. 5, 1961).

The stereochemical course of the base-catalyzed hydrogen–deuterium reaction at saturated carbon was investigated in t-butyl alcohol, diethylene glycol, and dimethyl sulfoxide as solvent. Substrates were 2-phenylbutane, 2-phenylbutane-2-d, 1-phenylmethoxyethane, and 1-phenylmethoxyethane-1-d. In t-butyl alcohol the exchange proceeded with as high as 97% net retention of configuration, in dimethyl sulfoxide with 100% racemization, and in diethylene glycol probably with small amounts of net inversion. The stereospecificity of these reactions is interpreted in terms of asymmetric solvation of a carbanion, itself symmetrical due to delocalization of charge into the benzene ring. Kinetics of the racemization reaction were studied in dimethyl sulfoxide and in t-butyl alcohol. The values of the rate constants with potassium t-butoxide as catalyst differed by a factor of 6 powers of 10 in the two solvents, the rate being slower in the hydroxylic (hydrogen bonding) solvent. Substitution of sodium for potassium t-butoxide made only small differences in t-butyl alcohol, but in dimethyl sulfoxide the value of the rate constant was depressed by a factor of 100 when the sodium base was used. The racemization was found to be approximately half order in potassium t-butoxide when run in dimethyl sulfoxide as solvent, and the rate was markedly depressed by addition of potassium iodide. (auth)

30650 ELECTROPHILIC SUBSTITUTION AT SATURATED CARBON. XV. ASYMMETRIC CARBANIONS, ASYMMETRIC SOLVATION AND d-ORBITALS OF SULFUR. Donald J. Cram, Donald A. Scott, and W. David Nielsen (Univ. of California, Los Angeles). J. Am. Chem. Soc., 83: 3696-3707(Sept. 5, 1961).

The stereochemical course of the base-catalyzed hydrogen–deuterium exchange reaction was studied through rate comparisons of racemization and exchange of 2-octyl phenyl sulfone and 2-octyl-2-d phenyl sulfone in deuterated and non-deuterated solvents. The exchange rates exceeded the racemization rates by factors that ranged from a low of 10 to a high of 1980, depending on the solvent, and in one solvent on the character of the base. In dissociating solvents such as ethylene glycol and dimethyl sulfoxide–methanol mixtures, and in the non-dissociating solvent t-butyl alcohol with tetramethylammonium hydroxide as base, the smaller factors and lower degrees of retention of configuration were observed. In t-butyl alcohol with potassium t-butoxide as base, the larger factors were obtained. These facts coupled with similar experiments carried out previously on other systems indicate that in dissociating solvents, most of the stereospecificity arises from the asymmetry of the carbanion intermediate, and some from asymmetric solvation. In associating solvents, asymmetric solvation plays an important role in the high retention observed for the reaction. The configurational stability of carbanions attached to the sulfone group is attributed to overlap between the d-orbitals of sulfur and the orbital occupied by the two electrons of the anion. Hydrogen–deuterium isotope effects for both the exchange and racemization reactions were measured, and found to vary between extremes of 0.3 and 1.9. These low values are interpreted as evidence that both the exchange and racemization rates are governed by mechanisms that involve kinetically distinguishable, discrete stages in which covalent bonds between carbon and hydrogen, or oxygen and hydrogen are neither made nor broken. (auth)

30651 FIRST OBSERVATION OF AQUEOUS TETRAVALENT CURIUM. Thomas K. Keenan (Los Alamos Scientific Lab., N. Mex.). J. Am. Chem. Soc., 83: 3719-20 (Sept. 5, 1961).

Curium tetrafluoride was prepared by treating CmF_3 with elemental fluorine. Addition of the resulting CmF_4 to 15 M NH_4F, either at 25 or 0°, produced only vigorous bubbling

accompanied by the immediate formation of white CmF_3 from the yellow CmF_4. It is believed that Cm(IV) oxidizes NH_4^+ under these conditions. However, upon addition of CmF_4 to 15 M CsF at 0°, a solution of tetravalent curium as a fluoride complex is obtained. The spectrum of the compound is discussed. (P.C.H.)

30652 A NOVEL HYDRIDE OF VANADIUM. Arnulf J. Maeland, Thomas R. P. Gibb, Jr., and David P. Schumacher (Tufts Univ., Medford, Mass.). J. Am. Chem. Soc., 83: 3728-9(Sept. 5, 1961).

The synthesis of vanadium dihydride is reported. A commercial, stainless steel hydrogenation apparatus was used. The bomb was charged with 6 g of $VH_{0.40}$, evacuated, and filled with hydrogen to a pressure of 70 atm. Analysis by thermal decomposition and measurement of the hydrogen evolved gave $VH_{1.45\pm0.05}$. An attempt to increase the hydrogen content resulted in $VH_{1.64\pm0.05}$. Another dihydride was prepared by treating a mesh sample of $VH_{0.87}$ with 10% HF. The value of the lattice constant for the dihydride determined was 4.271 ± 0.002 Å. The formula was found to be $VH_{1.77\pm0.05}$ by hydrogen loss in vacuo. (P.C.H.)

30653 STRUCTURE OF THE BAND SPECTRUM OF CuCl MOLECULE. I. ADDITIONAL KNOWLEDGE IN THE COARSE STRUCTURE. P. Ramakoteswara Rao and J. K. Brody (Argonne National Lab., Ill.). J. Chem. Phys., 35: 776-87(Sept. 1961).

A number of new bands in the A, B, C, D, and E systems of CuCl, recorded in the spectrum of the molecule excited in an electrodeless discharge tube by a microwave oscillator, are reported. Because of the employment of high dispersion and the use of a single isotopic species of CuCl ($Cu^{63}Cl^{35}$), it was possible to investigate the phenomenon of formation of head of heads in the $\Delta v = -4$ sequence of the E system. This phenomenon was also detected in the $\Delta v = -3$ sequence of the A system. The weak F system was photographed for the first time under suitable dispersion so that a satisfactory vibrational analysis of the same could be made. The R heads of this system of the $Cu^{63}Cl^{35}$ molecule are represented by the formula $\nu^F_{63,35} = 25287.0 + 386.8(v' + {}^1/_2) - 1.64(v' + {}^1/_2)^2 - 417.1(v'' + {}^1/_2)^2 + 1.50(v'' + {}^1/_2)^2$. It is shown that the lower state of the F system is the same as the common lower state of all the other known band systems, which is also the ground state of the molecule. Data on the A and F systems of the $Cu^{65}Cl^{35}$ molecule also are given. (auth)

30654 VAPOR PRESSURE OF ANTIMONY BY THE TORSION-EFFUSION METHOD. Gerd M. Rosenblatt and C. Ernest Birchenall (Princeton Univ., N. J.). J. Chem. Phys., 35: 788-94(Sept. 1961).

The pressures and mean molecular weights of the vapors over solid antimony (420-550°C) and solid zinc (250-335°C) were determined by simultaneous measurements by the torsion-momentum and Knudsen weight loss methods. The torsion measurement was calibrated with mercury at 30° using a mercury vapor pressure of 2.96×10^{-3} mm Hg determined by concurrent weight loss experiments. Zinc vapor is confirmed to be monatomic. The zinc pressure data are represented by $\log P_{mm} = (8.741 \pm 0.218) - (6630 \pm 125)/T$ giving $\Delta H_{298}°$ (vap) = 30.73 ± 0.57 and 31.18 ± 0.12 kcal/mole by the second law and third law of thermodynamics, respectively, in excellent agreement with previously reported results. The vapor over solid antimony is all Sb_4 molecules within experimental error. Least-squares analysis of the antimony data yields $\log P_{mm} = (10.571 \pm 0.090) - (10\,300 \pm 68)/T$, pressures 10-40% lower than those previously reported. The heat of vaporization of Sb_4(g) at 298.16°K is 49.83 ± 0.31 kcal/mole by the second law and 49.45 ± 0.09 by the third law of thermodynamics. (auth)

30655 LEAST-SQUARES LOCAL-ENERGY METHOD FOR MOLECULAR ENERGY CALCULATIONS USING GAUSS QUADRATURE POINTS. A. A. Frost, R. E. Kellogg, B. M. Gimarc, and J. D. Scargle (Northwestern Univ., Evanston, Ill.). J. Chem. Phys., 35: 827-31(Sept. 1961).

The least-squares local-energy method previously described and tested in calculations on H_2^+ was further tested on H_2^+, He, and H_2. The theory of Gauss quadrature is used to provide a better basis of points over which to average the local-energy. The electronic energy is easily calculated to six significant figures for H_2^+ and to three or four significant figures for He and H_2. (auth)

30656 PHOTOIONIZATION OF Ce^{3+} IN GLASS. Jackson S. Stroud (Corning Glass Works, Corning, N. Y.). J. Chem. Phys., 35: 844-50(Sept. 1961).

The photoionization of Ce^{3+} is investigated by determining the optical absorption changes and the electron spin resonance changes that occur when cerium-containing silicate glasses are illuminated with ultra-violet light. The results are: the room temperature quantum yield of photoelectrons from Ce^{3+} is 0.1; the optical absorption and the electron spin resonance bands caused by trapped photoelectrons are found; and a Ce^{3+} ion from which a fourth electron was removed by photoionization is different from a Ce^{4+} ion. (auth)

30657 VAPOR PRESSURES OF THE INERT GASES. Charles E. Hamrin, Jr. and George Thodos (Northwestern Univ., Evanston, Ill.). J. Chem. Phys., 35: 899-902(Sept. 1961).

A single vapor-pressure relationship applicable from the triple point to the critical point was found to exist for the inert gases argon, krypton, and xenon when the reduced vapor pressure P_R is related to T_R the reduced temperature. For these inert gases $\beta = -2.2936$ and $\gamma = -2.6786$ while α can be calculated from the boundary condition, $\alpha + \beta + 0.1832 = 0$. The vapor-pressure data for helium and neon produced similar reduced-vapor-pressure relationships having different constants. These results are not unexpected in view of the significant quantum effects associated with helium and to a lesser degree with neon. Values calculated with this reduced-vapor-pressure equation were found to be in excellent agreement with experimental values reported for argon, krypton, and xenon. The average deviation for these gases was 0.63%, for neon 1.51%, and for helium 0.79%. (auth)

30658 EFFECT OF PRESSURE ON THE SPECTRA OF TRANSITION METAL IONS IN MgO AND Al_2O_3. S. Minomura and H. G. Drickamer (Univ. of Illinois, Urbana). J. Chem. Phys., 35: 903-7(Sept. 1961).

The effect of pressure to 150 kbar was measured on the spectra of several transition metal ions in MgO and Al_2O_3. In general, there is an increase in crystal field strength with increasing pressure. The interelectronic repulsion parameter decreased slightly with increasing pressure indicating a small increase in covalency. For Al_2O_3, Dq shifts as $(V_0/V)^{5/3}$ indicating that the R^{-5} law holds, and the local compressibility is the same as the bulk compressibility. In MgO the shift is always more rapid than R^{-5}, indicating local relaxation near the foreign ion. Above about 50 kbar there is a marked increase of trigonal distortion in Al_2O_3. (auth)

30659 STUDIES OF THE OPTICAL AND INFRARED ABSORPTION SPECTRA OF RUTILE SINGLE CRYSTALS.

Bernard H. Soffer (Massachusetts Inst. of Tech., Cambridge). J. Chem. Phys., 35: 940-5(Sept. 1961).

The optical absorption of single crystals of synthetic rutile was investigated in the spectral range 1200 to 25,000 cm^{-1} from room temperature to 1000°C. The electronic absorption exhibits dichroic behavior. The edge moves toward lower energies as temperature in increased, with the shift depending upon the absorption coefficient; for a decadic absorption coefficient α' of 400 cm^{-1}, the shift is -7.1×10^{-4} ev/°K, while at 1 cm^{-1} it is -9.5×10^{-4} ev/°K. The broad band in the region of 6850 cm^{-1} which occurs in reduced rutile does not appear in fully oxidized rutile, even at high temperatures. At high temperatures an additional wavelength-independent absorption appears which can be correlated in good agreement with d-c conductivity by applying the Drude-Zener theory of free carrier absorption. New bands in the 3300 cm^{-1} region are shown to stem from O–H valence vibrations. The main bands are unusually sharp, with peaks at 3277 and 3322 cm^{-1} and half-widths of 28 and 13 cm^{-1}. A satellite structure of combination and difference bands was also detected. Deuterium substitution produces an absorption band at 2442 cm^{-1}. The entire structure shows a marked dependence of the absorption on the polarization direction of the light. Some evidence is presented that these O–H groups cause a dielectric dispersion. (auth)

30660 MEASUREMENT OF THE RESISTIVITY OF CESIUM AT ELEVATED TEMPERATURES. Julius Hyman, Jr. (Rocketdyne, Canoga Park, Calif.). J. Chem. Phys., 35: 992-4(Sept. 1961).

An experiment is described in which the electrical resistivity of liquid cesium was measured from ambient temperature to 419°C, and experimental values are presented. In the low-temperature region the data agree quite well with other measurements. A linear approximation which best correlates the data from the melting point to 419°C to ±1% is $\rho C_s = 38.5[1 + 0.00308(T - 50)]$ μ ohm-cm. Here T is temperature in degrees centigrade. By use of the Widemann-Franz relation, a thermal conductivity of 0.048 to 0.050 cal/sec-deg C-cm is predicted. (auth)

30661 COHESIVE ENERGIES OF EUROPIUM, GADOLINIUM, HOLMIUM, AND ERBIUM. O. Conrad Trulson, Donald E. Hudson, and Frank H. Spedding (Ames Lab., Ames, Iowa). J. Chem. Phys., 35: 1018-26(Sept. 1961). (IS-175)

A mass spectrometric method was employed to study the solid–gas phase change in four rare earth metals. The enthalpies of sublimation in kcal/M reduced to 298°K are: Eu, 43.11 ± 0.25; Gd, 81.22 ± 0.32; Ho, 75.04 ± 0.44; and Er, 75.39 ± 0.34. The corresponding cohesive energies in kcal/M as determined from presently available thermodynamic data are: Eu, 43.4; Gd, 81.9; Ho, 75.5; and Er, 75.7. A summary of the cohesion in the rare-earth series is included. A qualitative explanation of the unexpected variations is given in terms of the energetics of the metallic and gaseous states. (auth)

30662 THERMODYNAMIC PROPERTIES OF NONSTOICHIOMETRIC URANIA-ZIRCONIA SOLID SOLUTIONS. S. Aronson and J. C. Clayton (Westinghouse Electric Corp., Pittsburgh). J. Chem. Phys., 35: 1055-8(Sept. 1961).

Thermodynamic information was obtained at temperatures in the neighborhood of 1000°C, on nonstoichiometric urania–zirconia solid solutions, $U_yZr_{1-y}O_{2+x}$, with y values of 0.90, 0.80, and 0.70 and x values between 0.04 and 0.17. A solid state electrochemical technique was used. Partial molar free energies, entropies, and enthalpies of solution of oxygen in the solid were calculated. The results are compared with results previously obtained on nonstoichiometric urania and urania-thoria solid solutions. (auth)

30663 EFFECT OF AN ATTRACTIVE POTENTIAL ON THE CLASSICAL THEORY OF VIBRATIONAL ENERGY EXCHANGE. R. E. Turner (Clarendon Lab., Oxford) and Donald Rapp. J. Chem. Phys., 35: 1076-7 (Sept. 1961).

The complete dynamical problem for a "Morse"-type potential, consisting of an attractive term in addition to the exponential repulsion, was solved. A more rigorous correction for the attractive forces is therefore proposed. (auth)

30664 VIBRATIONAL SPECTRA OF INORGANIC MOLECULES. II. INFRARED REFLECTION SPECTRA OF LIQUID LITHIUM, SODIUM, POTASSIUM, AND SILVER NITRATES. J. K. Wilmshurst and S. Senderoff (Union Carbide Corp., Parma, Ohio). J. Chem. Phys., 35: 1078-84(Sept. 1961).

The optical constants of liquid lithium, sodium, potassium, and silver nitrates were obtained by a one-angle-reflection method. The derived absorption spectra are consistent with previously determined spectra and suggest that in all melts, the point group symmetry of the cations about the nitrate ion does not contain D_{3h} as a subgroup. Further, in both lithium and silver nitrate the highest symmetry subgroup common to the nitrate ion and the surrounding cations is at most C_{2v} and in these melts the nitrate ion is not rotating freely about its threefold axis. In all the melts there is a low-frequency band which must be ascribed to a cation-anion vibration of a lattice-like type. The intensity of the a_2'' band is discussed, and the bond dipole moment derived is interpreted in terms of the polarizing field of the cations. (auth)

30665 NOTE ON THE STATISTICAL THEORY OF MASS SPECTRA. John C. Schug and Norman D. Coggeshall (Gulf Research and Development Co., Pittsburgh). J. Chem. Phys., 35: 1146-7(Sept. 1961).

A simplification, through which the parameters can be studied without trial and error methods, is presented. Relative abundances of $C_nH_{2n+1}^+$ ions in low-voltage patterns of n-paraffins were examined, and some typical results are tabulated. It is pointed out that identical treatments of high-energy spectra give much more reasonable results. (P.C.H.)

30666 FLUORINATION OF THE TRIOXIDES OF CHROMIUM, MOLYBDENUM, TUNGSTEN, AND URANIUM BY SELENIUM TETRAFLUORIDE. Neil Bartlett and P. L. Robinson (Kings Coll., Newcastle-upon-Tyne, Eng.). J. Chem. Soc., 3549-50(Aug. 1961).

Reactions between selenium tetrafluoride and the transition metal trioxides of Group VI were investigated. The reactions of SeF_4 and IF_5 with the Group VIA trioxides are shown, and details are given on the preparation of each. (P.C.H.)

30667 AN EMPIRICAL SURFACE TENSION-TEMPERATURE RELATION FOR LIQUID METALS. S. W. Strauss (Naval Research Lab., Washington, D. C.). J. Nuclear Energy, Pts. A and B. Reactor Sci. and Technol., 15: 28-29(Sept. 1961).

The surface tension-temperature relation $\gamma = 0.59\ S^{1/6}(T_c - T)(T_c - T_m)^{-1}$ for liquid metals, is derived from the relation $\gamma_m = 0.59\ S^{1/6}$. In the derivation, the almost linear temperature dependence of surface tension and the vanishing of the surface tension at the critical temperature are considered. It was found that for the temperature ranges plotted, the differences between the experimental and calculated surface tensions were less than 11%. (L.N.N.)

30668 CATION EXCHANGE EQUILIBRIA WITH DIVALENT IONS. H. F. Walton, D. E. Jordan, S. R. Samedy, and W. N. McKay (Univ. of Colorado, Boulder). J. Phys. Chem., 65: 1477-84(Sept. 1961).

Equilibrium distributions were measured for exchanges of hydrogen ions in sulfonated polystyrene resins with perchlorates of Ba^{2+}, Cd^{2+}, Pb^{2+}, and UO_2^{2+}. Three degrees of resin crosslinking were used, and each exchange was studied at two or more temperatures. Values of ΔF^0 and ΔH were evaluated. Activity coefficient ratios for the pairs of ions $Cd^{2+}-H^+$ and $Pb^{2+}-H^+$ in perchlorate solutions were found from emf measurements, and water and salt uptakes of the resins were measured. The binding of metal ions by the resins increased with crosslinking, solution concentration, temperature (except for Ba^{2+}), and proportion of metal ion in the resin. Evidence is presented for formation of ion pairs. (auth)

30669 E. M. F. MEASUREMENTS IN MOLTEN BISMUTH–BISMUTH TRICHLORIDE SOLUTIONS. L. E. Topol, S. J. Yosim, and R. A. Osteryoung (Atomics International, Canoga Park, Calif.). J. Phys. Chem., 65: 1511-16(Sept. 1961).

Emf studies on cells of the type C, $Bi(N_1)$, $BiCl_3(1-N_1)||$ $BiCl_3(1-N_2)$, $Bi(N_2)$, C where N denotes mole fraction, were made at 238, 270, 300, 325, and 350°; also, the effects of varying acidity were observed by examining a cell containing a 70 mole % $BiCl_3$–30 mole % KCl melt at 325°, and another with a 75% $BiCl_3$–25% $AlCl_3$ melt at 270°. The Bi concentration N_1 in the reference half-cell was held constant, and the Bi concentration N_2 in the other half-cell was varied from 0 to about 0.06 by coulometric addition. A cell containing higher concentrations, $N_2 = 0.07$ to 0.25, was studied in a similar manner. Plots of the emf vs. log Bi concentration yielded initially straight lines which changed slope at low metal concentrations, $N_2 < 0.01$; the metal concentration at which this departure from linearity occurred increased with temperature and with the acidity of the system. For the low concentration region a slope corresponding to a Nernst n of 2.05 ± 0.10, consistent with the species Bi^+, was found at all temperatures. The data for the higher Bi concentrations, $N_2 > 0.01$, are interpreted in terms of the species Bi_4Cl_4. The equilibrium constant, K_N, for the reaction $4BiCl = Bi_4Cl_4$ can be expressed as $\log K_N = [(4.49 \pm 0.54) \times 10^3]/T°K - 1.930 \pm 0.945$ for $N_{Bi} < 0.09$ and the temperature range 238 to 350°. (auth)

30670 THE ELECTROLYSIS OF SODIUM AMALGAMS. John C. Angus and Edward E. Hucke (Univ. of Michigan, Ann Arbor). J. Phys. Chem., 65: 1549-51(Sept. 1961).

The electrolysis of 0.097 and 0.485 wt % sodium amalgams was studied at temperatures up to 344°. Below approximately 290° the sodium is transported to the anode; above 290° the direction of transport reverses and the sodium migrates to the cathode. This effect, which has heretofore never been observed, is postulated as caused by the thermal decomposition of compounds or associations which persist in the liquid amalgam. (auth)

30671 THE RATES OF THE ALKALINE HYDROLYSES OF ETHYL α-HALOACETATES IN PURE AND MIXED SOLVENTS. George J. Nolan and Edward S. Amis (Univ. of Arkansas, Fayetteville). J. Phys. Chem., 65: 1556-60 (Sept. 1961).

The rates of the basic hydrolyses of several ethyl α-haloacetates were measured at temperatures 15.00, 25.00, and 30.00° in water and in 49.75 and 91.77 wt % ethanol-in-water. The effects of halogen substitution and of solvent on the rates of hydrolyses were determined, and partial explanations of these effects are considered. Energies and entropies of activation and Arrhenius frequency factors were calculated from the rate data and are used in conjunction with the discussion of the rates. The order of the rates of hydrolyses of the ethyl α-multihalogen-substituted esters was explained on the basis of inductive effects, while the order of the rates of hydrolyses of the ethyl α-monohaloesters was explained on the basis of inductive effects in conjunction with other effects. The dielectric constant dependence of the rates was accounted for by an equation formerly proposed by Amis and based on electrostatics. (auth)

30672 ACID DISSOCIATION CONSTANTS AND COMPLEX FORMATION CONSTANTS OF SEVERAL PYRIMIDINE DERIVATIVES. Edmond R. Tucci, Edward Doody, and Norman C. Li (Duquesne Univ., Pittsburgh and Christian Brothers Coll., Memphis). J. Phys. Chem., 65: 1570-4(Sept. 1961).

Acid dissociation constants of uracil-5-carboxylic acid (isoörotic acid), 2-ethylthio-isoörotic acid, uracil-6-carboxylic acid (orotic acid), 5-nitroörotic acid, and adenosine-5′-monophosphate were determined at an ionic strength of 0.1, 25°. The formation constants of the Cu(II), Ni(II), Co(II), Zn(II), Mn(II), and Cd(II) complexes of some of these pyrimidine derivatives were determined using pH and ion-exchange methods. The binding sites in uracil-5-carboxylic acid and 2-ethylthio-isoörotic acid toward metal ions are probably the carboxylate anion and the adjacent oxygen atom. The postulated sites in 5-nitroörotic acid toward metal ions and uracil-6-carboxylic acid toward Ni ion are the carboxylate and adjacent ring nitrogen anions. The formation constants of the zinc complexes of uracil-5-carboxylic acid and 5-nitroörotic acid, and of the sodium and manganous complexes of adenosine-5′-monophosphate obtained by the pH method are in agreement with the corresponding values obtained by the ion-exchange method, indicating that these complexes are mononuclear. (auth)

30673 THE EFFECT OF TEMPERATURE ON ION-EXCHANGE EQUILIBRIA. IV. THE COMPARISON OF ENTHALPY CHANGES CALCULATED FROM EQUILIBRIUM MEASUREMENTS AND CALORIMETRICALLY MEASURED VALUES. O. D. Bonner and J. R. Overton (Univ. of South Carolina, Columbia). J. Phys. Chem., 65: 1599-1602(Sept. 1961).

Ion-exchange equilibria between hydrogen and lithium ion on Dowex 50 resins of 4, 8, and 16% DVB content were studied over the temperature range 0 to 98° while maintaining a constant solution ionic strength of 0.1 M. Calorimetric measurements of the heat of exchange of hydrogen for lithium and sodium for hydrogen ion were made on these same resins at 25°. The calorimetric measurements confirm the effect of resin composition on the heat of exchange as calculated from the equilibrium measurements at the various temperatures. The data for the hydrogen–lithium exchange indicate that the ion-exchange process may be considered enthalpy-wise as primarily a concentration of one ionic species with the simultaneous dilution of the other. In the exchange of sodium for hydrogen ion it appears that there is a considerable contribution to the heat effect caused by the ionization of the acid exchange sites when the resin is predominantly in the salt form. (auth)

30674 THE ACTIVITY AND OSMOTIC COEFFICIENTS OF SOME p-TOLUENESULFONATES AT 40, 60, AND 80°. O. D. Bonner and William C. Rampey (Univ. of South Carolina, Columbia). J. Phys. Chem., 65: 1602-4(Sept. 1961).

Osmotic and activity coefficients were determined for lithium, sodium, and potassium p-toluenesulfonates and

p-toluenesulfonic acid at 40, 60, and 80° by isopiestic comparisons with solutions of sodium chloride. In concentrated solutions the coefficients of the lithium and hydrogen sulfonates decrease while those of potassium sulfonate increase with increasing temperature. The behavior of the sodium sulfonate as the temperature changes approximates that of sodium chloride. These variations are explained as resulting from an increase of kinetic energy and a decrease of ionic hydration at elevated temperatures. The behavior of the activity coefficients of these sulfonates is related to the decrease of resin selectivity with increasing temperature in ion-exchange equilibria. (auth)

30675 COMPLEX IONS IN FUSED SALTS. CADMIUM AND LEAD BROMIDES. F. R. Duke and H. M. Garfinkel (Ames Lab., Ames, Iowa). J. Phys. Chem., 65: 1627-9 (Sept. 1961). (IS-228)

The bromo-complexes of lead and cadmium were studied by following the emf of a concentration cell as a function of metal ion concentration. This was done at various initial bromide ion concentrations and several temperatures. The results show that the mono- and tri-bromo species in the cadmium system are thermodynamically important although the formation constants exhibit a definite temperature dependence. It is shown that deviations from ideal behavior in reciprocal molten salt solutions can be ascribed to complex ion formation. When applied to the experimental data the chemical and lattice-model approaches are hardly distinguishable. The data are tabulated. (P.C.H.)

30676 COMPLEX IONS IN FUSED SALTS. EFFECT OF SOLVENT CATION. H. M. Garfinkel and F. R. Duke (Ames Lab., Ames, Iowa). J. Phys. Chem., 65: 1629-31 (Sept. 1961). (IS-229)

The formation constants for Ag^+Cl^- and $AgCl_2^-$ were determined as a function of solvent cation concentration by following the change in emf on the addition of Cl, for different mole fractions of $KNO_3(N_K)$, mixed with $NaNO_3$. Typical data are tabulated. The variation found in the equilibrium constants for the formation of Ag^+Cl^- and $AgCl_2^-$ may be ascribed to coulombic effects. It was found that K_{1a}/K_{1b} was approximately 1.6 and the ratio determined experimentally was 2.5. (P.C.H.)

30677 THERMOCHEMISTRY OF ZIRCONIUM HALIDES. A. G. Turnbull (Commonwealth Scientific and Industrial Research Organization, [Melbourne]). J. Phys. Chem., 65: 1652-4(Sept. 1961).

Thermodynamic properties such as heats of reaction, heats of formation, and entropies are given for $ZrBr_4$, $ZrCl_4$, ZrI_4, and $HfCl_4$ in both sodium hydroxide and water. Values for the heats of reaction are tabulated. (P.C.H.)

30678 REDUCTION OF ZIRCONIUM AND HAFNIUM OXIDES. F. K. McTaggart (Commonwealth Scientific and Industrial Research Organization, Victoria, Australia). Nature, 191: 1192(Sept. 16, 1961).

In an electrostatic field of 2500 mc/s a surface layer was formed on ZrO_2 which was black or golden. The material had a specific resistivity of the order of 1 ohm-cm. The Zr : O ratio was not determined, but x-ray diffraction indicated that no change of phase occurred. Hafnium oxide, when treated in the same way, also became black and conducting. Thorium oxide remained unchanged. It appears that a reduction took place in the case of ZrO_2 and HfO_2 similar to that occurring when TiO_2 is reduced in hydrogen at red heat. (P.C.H.)

30679 EFFECT OF THE PRECIPITATION OF DISSOLVED $MnCl_2$ ON THE LOW-TEMPERATURE THERMAL CONDUCTIVITY OF NaCl. Miles V. Klein (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 123: 1977-85(Sept. 15, 1961).

Low-temperature thermal conductivity measurements were made on NaCl crystals doped with 10^{-4} mole fraction $MnCl_2$. The manganese ions were first quenched into approximate solid solution and then allowed to age at room temperature. Approximate kinetics of the precipitation that resulted were measured by electron spin resonance. There was surprisingly little change in the conductivity during aging; in particular a low-temperature decrease did not appear. The conclusion was that the presence of clusters cannot be invoked to explain the greater than Rayleigh scattering cross section often observed with point defects at low temperatures. The small conductivity changes that did result were a depression at temperatures near that of the conductivity maximum, and a gradual rise at higher temperatures toward the values obtained with an undoped crystal. These changes were most rapid near the end of the clustering process and suggest a change in the nature of the precipitate at this stage. (auth)

30680 THEORY OF TRANSITION ION COMPLEXES. W. Marshall (Atomic Energy Research Establishment, Harwell, Berks, Eng.) and R. Stuart. Phys. Rev., 123: 2048-58(Sept. 15, 1961). (UCRL-6228)

It is suggested that the observed lowering of the spin-orbit parameters in transition-ion complexes is caused by a screening effect which expands the 3d wave functions. Evidence in support of this suggestion is given by neutron diffraction form-factor measurements on Mn^{2+} salts. The theory of the transferred hyperfine interaction between the electron spin of Mn^{2+} and surrounding F^{19} nuclei is discussed, and the complications introduced into the theory when dealing with other ions are described. The theory is found to be unsatisfactory because it is not possible to treat the interaction via the 1s orbitals of F^- with sufficient accuracy. (auth)

30681 THE ELECTRONIC SPECIFIC HEAT OF LITHIUM ISOTOPES. Douglas L. Martin (National Research Council of Canada, Ottawa). Proc. Roy Soc. (London), A263: 378-86(Sept. 19, 1961).

The specific heats of natural lithium (predominantly Li^7) and of lithium containing 99.3% Li^6 determined from 0.4 to 1.5°K. There is no significant difference in the electronic specific heats, the coefficient of this term being about 390 μcal $°K^{-2}$ g $atom^{-1}$ (163 mJ $°K^{-2}$ g $atom^{-1}$). The significance of this result is discussed. (auth)

30682 THE ELECTRICAL RESISTIVITY OF LITHIUM-6. J. S. Dugdale, D. Gugan, and K. Okumura (National Research Council of Canada, Ottawa). Proc. Roy. Soc. (London), A263: 407-19(Sept. 19, 1961).

The electrical resistivities of lithium-6 and lithium of natural isotopic composition were studied between 4°K and room temperature. In addition, their absolute resistivities were carefully compared at room temperature. These measurements show that the effect of ionic mass on electrical resistivity agrees with simple theoretical predictions, namely, that the properties of the conduction electrons in lithium do not depend on the mass of the ions, and that the characteristic lattice frequencies for the two pure isotopes are in the inverse ratio of the square roots of their ionic masses. A comparison with previous specific heat results, where the simple theory is found not to hold, indicates the possibility that anharmonic effects are present which affect the specific heat but not the electrical resistivity. (auth)

30683 SORPTION OF LONG-LIFE FISSION PRODUCTS BY SOILS AND CLAYS. Yu. A. Kokotov, R. F. Popova, and A. P. Urbanyuk. Radiokhimiya, 3: 199-206(1961). (In Russian)

Sorption of Sr^{90} and Cs^{137} by soils and clays is analyzed.

Distribution coefficients of Sr^{90} in various soils are determined and the effects of macrocomponents and pH on distribution are studied. Sr^{90} may be washed from the upper soil, in soils with low volume exchange, with 0.01n salt solution. Macroquantities of Cs^{137} are fixed in the soils and cannot be washed away by salt solutions. (R.V.J.)

30684 STATISTICO-THERMODYNAMICAL STUDIES ON THE OXIDATION EQUILIBRIA OF URANIUM DIOXIDES Sakae Takeuchi (Tohoku Univ., Sendai) and Yasutoshi Saito. Trans. Japan Inst. Metals (Sendai), 1: No. 1, 1-8(July 1960). (In English)

The process of oxidation and the oxidation equilibria were investigated on a homogeneous phase of a uranium oxide containing oxygen in stoichiometric excess. The rate of oxidation of UO_2 was measured in the range from 175 to 360°C by means of a spring thermobalance, and it was found that the oxidation in the concentration range of UO_2 to U_3O_7 occurred in a different process from that in the range of U_3O_7 to U_3O_8. From the results of measurements of the activation energy for oxidation, the dependence of the lattice constant on oxygen concentration in the range from UO_2 to U_3O_7, and the observation on the change in density, it was deduced that the oxidation proceeds through the diffusion of oxygen ions which are produced from atmospheric oxygen by the reaction on the surface of the UO_2 crystal accompanied with the formation of electron deficits among uranium ions in the crystal. On the assumptions that these oxygen ions in stoichiometric excess occupy the interlattice points in the UO_2 crystal of the fluorite lattice type and the election deficits are randomly distributed among uranium ions in the form of U^{6+} ions, the correlation between the equilibrium oxygen pressure and the oxygen concentration of the UO_2 crystal containing oxygen in stoichiometric excess was theoretically calculated. (auth)

30685 ABOUT ANHYDROUS RUTHENIUM TRIBROMIDE. S. A. Shchukarev, N. I. Kolbin, and A. N. Ryabov. Vestnik Leningrad. Univ., 16: No. 4, Ser. Fiz. i Khim. No. 1, 100-4(1961). (In Russian)

Anhydrous ruthenium tribromide was synthesized. Its density and interplane distances ($d_4^{20} = 5.42$) were found. The thermal dissociation of $RuBr_3$ is studied. From these data the thermodynamic functions for $Ru_{sol} + 3/2\ Br_{2g} \rightarrow RuBr_{sol}$ were found to be $\Delta F_{298} = -30 \pm 4$ kcal, $\Delta H = -44 \pm 2$ kcal, $\Delta S_{298} = -49 \pm 2$ cal per mole per °K. (tr-auth)

30686 OXIDATION RATE OF RUTHENIUM (4+) NITRATE AND RUTHENIUM (4+) HYDROXYCHLORIDE IN WATER SOLUTIONS BY OZONE. A. A. Goryunov. Vestnik Leningrad. Univ., 16: No. 4, Ser. Fiz. i Khim. No. 1, 105-15(1961). (In Russian)

The oxidation rate of simple ruthenium compounds in water solutions by ozonized oxygen was studied. At equilibrium the reaction is of zero order. At high concentrations of nitric and especially of hydrochloric acid the oxidation rate is strongly lowered due to the formation of strong complex compounds. At low temperatures and high concentrations of nitric acid, step-by-step oxidation through unstable, probably hexavalent, states having a bright emerald-green color is observed. (tr-auth)

30687 INFLUENCE OF PREPARATION METHODS ON THE STATE OF NIOBIUM TRACES IN NITRIC ACID SOLUTION. V. I. Paramonova and A. V. Zharkov. Vestnik Leningrad. Univ., 16: No. 4, Ser. Fiz. i Khim. No. 1, 116-25(1961). (In Russian)

The content of colloidal forms of niobium dissolved in 2N HNO_3 was found to increase with increasing storage time in acidified solution (pH ≈ 3). All niobium solutions in 2N HNO_3 prepared by different methods, contain some neutral niobium complexes besides colloidal forms. Anionic niobium complexes obtained by the dilution of stock solution in 13 · 5N HNO_3 were found to be present together with the colloidal forms and neutral complexes. (tr-auth)

30688 PENETRATION OF ZIRCONIUM BY DEUTERIUM IONS UNDER THE INFLUENCE OF THE GASEOUS DISCHARGE. A. A. Rodina. Zhur. Fiz. Khim., 35: 1661-5(Aug. 1961). (In Russian)

The penetration of deuterium in zirconium during electric discharge in a strong magnetic field at low pressures was investigated. It is shown that under such conditions the atomic D : Zr ratio can attain a value up to 1.8. Maximum deuterium concentration is built up at a depth of ca. 1μ rather than at the cathode surface. In zirconium not reaching the saturation point deuterium is present in a quite sharply defined layer. It will diffuse out into the bulk of the metal at a marked rate on subsequent storage at room temperature. Treatment of the cathode by alternating discharge in deuterium and in hydrogen showed that the rate of diffusion of the latter in partially hydrogenated zirconium is considerably higher than in the pure metal. (auth)

30689 KINETICS OF THE CATHODIC AND ANODIC POLARIZATION OF A HYDROCHLORIC ACID SOLUTION OF UO_2^{2+}. Ya. P. Gokhshtein and Tasi-shen Gao (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR). Zhur. Fiz. Khim., 35: 1699-1705 (Aug. 1961). (In Russian)

The oxidation–reduction processes $UO_2^{2+} + e \rightleftharpoons UO_2^+$; $UO_2^+ + 2H^+ + 2e \rightharpoonup UO^+ + H_2O$; $UO^{2+} + e \rightleftharpoons UO^+$ on a mercury electrode are discussed. The cathodic and anodic waves of the first stage are reversible at moderate rates of change of potential. The second anodic waves correspond to the oxidation reaction $UO^+ \rightharpoonup UO^{2+}$ and maintain their reversible character even at high rates of potential change. Disproportionation becomes important at HCl concentrations exceeding 1N. The rate constants and free energies of the processes were calculated. (auth)

30690 ENTHALPY OF BERYLLIUM AND LITHIUM OXIDES AT HIGH TEMPERATURES. E. N. Rodigina and K. Z. Gomel'skiĭ (Mendeleev All-Union Scientific Research Inst. of Metrology, Sverdlovsk Branch, USSR). Zhur. Fiz. Khim., 35: 1828-31(Aug. 1961). (In Russian)

The enthalpy relative to 293.15°K was measured for lithium oxide in the range 373.20 to 1124.2°K and for beryllium oxide in the range 363.44 to 1127.9°K. Equations for the enthalpies are presented. (auth)

30691 BASIC CHLORIDES AND HYDROXIDES OF Eu, Tb, AND Ho. N. V. Aksel'rud and V. I. Ermolenko. Zhur. Neorg. Khim., 6: 777-82(Apr. 1961). (In Russian)

The composition, activity, and standard isobar potentials were determined for europium, terbium and holmium salts and hydroxides. The aging process of the compounds and changes in their composition and activity were analyzed. The activity dependence of Eu, Tb, and Ho salts and hydroxides on the chloride ion activities was investigated. (R.V.J.)

30692 COMPLEXING OF Pu(V) WITH ETHYLENEDIAMINETETRAACETIC ACID. O. L. Kabanova (Vernadskii Inst. of Geochemistry and Analytical Chemistry, USSR). Zhur. Neorg. Khim., 6: 786-9(Apr. 1961). (In Russian)

The composition and stability constants of two complexes formed between Pu(V) and ethylenediaminetetraacetic acid

were studied. The composition of the first complex is PuO_2Y^{3-}, while the molecular ratio of the second complex is $PuO_2^+Y^{4-}$ = 1:2. (R.V.J.)

30693 ON THE COMPLEXITY OF URANYL PEROXIDE COMPOUNDS. I. I. Chernyaev, V. A. Golognya, and G. V. Ellert (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zhur. Neorg. Khim., 6: 790-8(Apr. 1961). (In Russian)

An attempt is made to systematically classify and interpret uranyl peroxides and their structure based on the coordination theory and the available data on complex uranyl compound chemistry. (R.V.J.)

30694 INFRARED ANALYSIS OF THE BOND IN URANYL NITRATE COMPLEXES WITH U BUTYL PHOSPHATE COMPOUNDS. A. V. Nikolaev and S. M. Shubina. Zhur. Neorg. Khim., 6: 799-803(Apr. 1961). (In Russian)

An analysis was made by infrared absorption spectra of the bond in complex uranyl nitrate compounds with tributyl phosphate, butyl phosphinic acid, dibutyl ether, and tributyl phosphinoxide. It is shown that the complexing proceeds according to the bond P = 0 which causes the shifting of the absorption band of the bond. The unchanged band of the P−O−C bond indicates that uranyl nitrate does not complex with the extracting agent at this bond point. (R.V.J.)

30695 COMPLEX THORIUM COMPOUNDS WITH TARTARIC ACID. O. E. Zvyagintsev and L. G. Khromekov (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zhur. Neorg. Khim., 6: 874-82 (Apr. 1961). (In Russian)

The reaction of thorium with tartaric acid at a wide range of pH was studied. The synthesis of various complexes is reported, some of them synthesized for the first time. Approximate structural formulas are given for the compounds, and the instability constant for the cation complex $[ThH_2Tar]^{2+}$ is calculated. (R.V.J.)

30696 MOLECULAR STRUCTURE OF LITHIUM AND SODIUM METABORATES IN VAPORS. P. A. Akishin and V. P. Spiridonov (Moscow State Univ.). Zhur. Strukt. Khim., 2: No. 1, 63(Jan.-Feb. 1961). (In Russian)

Preliminary data are given from electronographic studies of $LiBO_2$ and $NaBO_2$ molecules in vapor, where r(B−O) = 1.36 Å, r(B=O) = 1.20 Å, r(Li−O) = 1.82 Å, r(Na−O) = 2.14 Å, <Li−O−B ≅ <Na−O−B ≅ 90° to 105°. (R.V.J.)

30697 ON THE NEW MODIFICATION OF β K_2UO_4. L. M. Kovba, E. A. Ippolitova, and Yu. P. Simanov (Moscow State Univ.). Zhur. Strukt. Khim., 2: No. 2, 211(Mar.-Apr., 1961). (In Russian)

Continuous calcination of α-K_2UO_4 (structural type K_2NiF_4) at 900°C in air results in the formation of a new phase, β-K_2UO_4; the Debye pattern of β-K_2UO_4 is tabulated. A cubic subcell a = 4.29 kX was found for K_4UO_5, however, the superstructure lines do not correlate with the lines for β-K_2UO_4. It is postulated that K_4UO_5, analogous to β-K_2UO_4, has a disordered dense potassium and oxygen packing. (R.V.J.)

30698 ON THULIUM BORIDES. Yu. B. Paderno and G. V. Samsonov (Inst. of Metal Ceramics and Special Alloys, Academy of Sciences, Ukrainian SSR). Zhur. Strukt. Khim., 2: No. 2, 213-14(Mar.-Apr., 1961). (In Russian)

X-ray diffraction analysis of thulium borides prepared at 1600 to 1900°C showed the presence of hexaboride and tetraboride with characteristic rare-earth boride structure. The lattice for the hexaboride is a = 4.102 kX (cubic lattice); for tetraboride a = 7.04 and c = 3.98 kX (tetragonal lattice). (R.V.J.)

30699 CRYSTAL CHEMISTRY OF COMPLEX COMPOUNDS. (A Review). M. A. Porai-Koshits (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zhur. Strukt. Khim., 2: No. 2, 218-37 (Mar.-Apr., 1961). (In Russian)

A review is given of the part played by crystal investigations in coordination chemistry. An attempt is made to formulate general steriochemical conclusions from x-ray diffraction analyses of various complex compounds. A detailed analysis is given of the crystal chemistry of complex compounds of the 8th group, showing the dependence of complex structure on the nature of the central atom and its addends. 126 references. (R.V.J.)

30700 RUBIDIĬ I TSEZIĬ. (Rubidium and Cesium). Second Expanded and Corrected Edition. F. M. Perel'man. Moscow, Publishing House of the Academy of Sciences, 1960. 140p.

A review is given of the physical and chemical properties of Rb and Cs and their salts and compounds. Methods of qualitative and quantitative analysis are discussed as well as the extraction of Rb and Cs from minerals and rocks. Production, electrochemistry, and applications are also discussed. 346 references. (R.V.J.)

30701 PURIFICATION OF ETHER. Robert N. Feinstein (to U. S. Atomic Energy Commission). U. S. Patent 3,003,002. Oct. 3, 1961.

A process for removing peroxides from ethers by sorption on a strong-base anion exchange resin in its hydroxyl form is described. Incorporation of the resin for storage is also covered. (AEC)

30702 METHOD OF DISSOLVING PLUTONIUM DIOXIDE IN NITRIC ACID USING CERIUM IONS. Archie S. Wilson (to U. S. Atomic Energy Commission). U. S. Patent 3,005,682. Oct. 24, 1961.

A method is described for catalyzing the dissolution of plutonium dioxide in nitric acid with small amounts of cerium ions. (AEC)

Radiation Chemistry and Radiochemistry

30703 (AD-259662) SOME LUMINESCENT PROPERTIES OF THE MIXED PHENYL- AND p-BIPHENYLYL-SUBSTITUTED SILANES UNDER ULTRA-VIOLET, GAMMA AND BETA EXCITATION (thesis). Carl Graham Weis (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio). Mar. 1961. 73p. (GNE/Phys/61-21)

Some of the luminescent properties of triphenyl-p-biphenylylsilane (silane I), biphenyl-di-p-biphenylylsilane (silane II) and phenyl-tri-p-biphenylylsilane (silane III) were investigated. These scintillators are all low-melting point, transparent, glassy solids which are easy to mold in various sizes and shapes. These phosphors were compared with anthracene. Silane I was 8% less effective than anthracene in its gamma detecting ability. The pulse height of the silanes was about 40 to 45% that of anthracene. Each of the silanes was about 70% as efficient a beta detector as is anthracene. Fluorescence spectra for each of the silanes under ultra-violet and beta stimulation are reported. Peak emission wave lengths were 400, 400, and 450 mμ for Silane I, II, and III respectively. Fluorescence decay constants of 2.53 to 2.54, 2.62 to 2.63 and 3.29 to 3.31 nanoseconds were found for Silane I, II, and III. (auth)

30704 (AEET/AM/17) RADIOCHEMICAL PROCEDURES FOR THE ASSAY OF LOW LEVELS OF STRONTIUM-90 ACTIVITY IN MILK, HUMAN BONE AND WATER. S. B. Hingorani (India. Atomic Energy Establishment, Trombay). Aug. 19, 1960. 14p. (A/AC.82/G/L.613)

A summary is presented of chemical procedures for the analysis of milk, human bone, and water for low levels of strontium-90. The estimation is carried out by normal analytical methods using the carrier technique and taking sufficient care to avoid losses in the stages of analysis. In the procedure used yields of 65 to 80% strontium, and 85 to 95% yttrium are obtained. (B.O.G.)

30705 (AERE-R-3721) THE STOICHIOMETRY OF THE RADIATION INDUCED REACTION BETWEEN CO_2 AND GRAPHITE. R. S. Sach (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Aug. 1961. 67p.

The relationship between CO production and graphite weight loss in the radiation-induced reaction between CO_2 and graphite has been examined in a gas circulation system in the DIDO reactor. In very few instances is there any simple relationship between CO production and graphite weight loss. The initial rate of CO production is affected by the number of unoccupied active free sites on the graphite surface, and by low concentrations of CO. Experiments using C^{14} indicate that considerable loss of CO occurs probably due to radiolysis. The rate of carbon transport to the gas phase is affected by the addition of CO in the range 0.2% to 5%. (auth)

30706 (BMI-1543) RADIATION-INDUCED GRAFT-POLYMERIZATION STUDIES. Francis A. Sliemers, Jr., John F. Kircher, William B. Gager, Israel S. Ungar, Emirhahn Gülbaran, and Robert I. Leininger. (Battelle Memorial Inst. Columbus, Ohio). Sept. 12, 1961. Contract W-7405-eng-92. 28p.

The preparation and irradiation of a number of acrylate and methacrylate polymers are described. The investigation of the mechanism of radiation attack on the polymers was continued. The chief tools of the investigation were free-radical measurements and the quantitative determination of the volatile products of irradiation. Several graft polymerization studies were initiated using conditions suggested by the data. The results indicate that polymer molecular weight appreciably affects free-radical formation, the constituents on the carbon atom located alpha with respect to the ester group as well as the size and configuration of the hydrocarbon tail of the ester group influence free-radical formation, a major portion of total free-radical formation is accomplished by means of a whole or partial ester scission, and free-radical formation is accompanied, in most cases, by a scission on the polymer backbone. (auth)

30707 (BNL-686) RADIATION INDUCED EFFECTS IN MAGNESIUM OXIDE CATALYSTS. J. Hoigne and D. Ballantine (Brookhaven National Lab., Upton, N. Y.). Apr. 6, 1961. Contract [AT(30-2)-Gen-16]. 43p.

An attempt was made to find a model system in which to study irradiation effects on heterogeneous catalysts. Preirradiation with gamma rays from cobalt-60 enhanced the rate of hydrogen conversion over magnesium oxide catalysts when the oxide was pretreated with oxygen at elevated temperature. No correlation was found between the catalytic activity and the formation of paramagnetic centers observed in the electron spin resonance spectra at room temperature. Irradiation produced no detectable change in the adsorption properties of magnesium oxide for hydrogen and carbon monoxide. (auth)

30708 (IDO-16706) RELATIONSHIP BETWEEN YIELDS OF DIMERS OF A POLYPHENYL AND ITS PARTIAL REACTION RATES. W. M. Hutchinson, H. R. Anderson, Jr., and P. W. Solomon (Phillips Petroleum Co. Research and Development Dept., Bartlesville, Okla.). Aug. 7, 1961. Contract AT(10-1)-1080. 18p.

Relative yields of dimers of biphenyl were related to its partial reaction rates. The yields of the six isomeric quaterphenyls from electron (Linac) irradiation of biphenyl at 500 to 600°F were obtained by gas chromatography. The yields were 2.6, 22, 18, 20, 28, and 9%, respectively, for o,o-, o,m-, o,p-, m,m-, m,p-, and p,p-quaterphenyl. The conversion of biphenyl was approximately 11%. The formation of the quaterphenyls is postulated to result from the reaction of an i^{th} biphenylyl radical with a j^{th} position on a biphenyl molecule. The yields of the six quaterphenyl dimers of biphenyl were interrelated. The r (reactivity) values obtained from the irradiation of biphenyl were consistent with the random formation of radicals. The k_0 value indicated that the ortho positions are severely hindered to attack by a biphenylyl radical at 500 to 600°F. The reported activation of the para position to radical attack at 80°C persists at the higher temperature. The relative yields of hexaphenyls from electron (Linac) irradiation of meta-terphenyl at 500 to 600°F were predicted. Nine are expected to constitute about 85% of the total yield of hexaphenyls. (auth)

30709 (NAS-NS-3043) THE RADIOCHEMISTRY OF GERMANIUM. Jacob A. Marinsky (Buffalo. Univ.). July 1961. 62p.

"Nuclear Science Series" of the National Research Council. Committee on Nuclear Science.

A review of the nuclear and chemical features of Ge which are of particular interest to radiochemists is presented together with a discussion of sample dissolution and activity measurement techniques. A collection of radiochemical procedures for Ge is also presented. (D.L.C.)

30710 (NAS-NS-3044) THE RADIOCHEMISTRY OF PLATINUM. G. W. Leddicotte (Oak Ridge National Lab.). 34p.

"Nuclear Science Series" of the National Research Council. Committee on Nuclear Science.

The general and analytical chemistry of Pt are reviewed and applications to the radiochemistry of Pt are discussed. Topics covered include the dissolution of samples containing Pt, counting techniques for radioactive Pt isotopes, radiochemical procedures for Pt radionuclides, and safety practices. A list is included of the radioactive nuclides of Pt. 111 references. (C.H.)

30711 (NAS-NS-3045) THE RADIOCHEMISTRY OF IRIDIUM. G. W. Leddicotte (Oak Ridge National Lab.). [1961]. 36p.

"Nuclear Science Series" of the National Research Council. Committee on Nuclear Science.

The general and analytical chemistry of Ir are reviewed and applications to the radiochemistry of Ir are discussed. Topics covered include dissolution of samples containing Ir, counting techniques for radioactive Ir isotopes, radiochemical procedures for Ir radionuclides, and safety practices. A list is included of the radioactive nuclides of Ir. 106 references. (C.H.)

30712 (NAS-NS-3046) THE RADIOCHEMISTRY OF OSMIUM. G. W. Leddicotte (Oak Ridge National Lab.). 24p.

"Nuclear Science Series" of the National Research Council. Committee on Nuclear Science.

The radiochemistry of osmium is presented. Included are a review of nuclear and chemical properties, a discussion of sample dissolution and counting, and a collection of

radiochemical procedures for the element as found in the literature. (J.R.D.)

30713 (NP-10820) THE EFFECT OF NUCLEAR REACTOR IRRADIATION DURING LOW TEMPERATURE CARBONIZATION OF BITUMINOUS COALS. J. A. Hammond and P. L. Walker, Jr. (Pennsylvania State Univ., University Park. Coll. of Mineral Industries). July 31, 1959. 49p. (SR-14)

The effect of irradiating bituminous coals during low temperature carbonization at a heating rate of 6°C/min up to 600°C was investigated. During carbonization, the rate of gas evolution and the gas composition was determined. The effect of irradiation on the carbonization process was found to be an increase in the swelling characteristics of the coals. There is probably no significant effect on the rate of gas evolution or its composition, the type of coke produced, or the yield of tar. (auth)

30714 (NYO-2481) A STUDY OF THE MECHANISM OF RADIATION-INDUCED GELATION IN MONOMER-POLYMER MIXTURES. Final Report. George Odian, Bruce S. Bernstein, Joseph Schaefer, Lawrence J. Friedman, and James Kelly (Radiation Applications Inc., Long Island City, N. Y.). July 13, 1961. Contract AT(30-1)-2554. 30p.

It was found that polyethylene can be radiation-crosslinked at lower radiation doses than normally required by the incorporation of certain di- and polyfunctional monomers into the polymer prior to radiation. Useful monomers are ethylene glycol dimethacrylate, polyethylene glycol dimethacrylate, triallyl cyanurate, diallyl itaconate, and allyl methacrylate. The crosslinking of polyvinyl chloride by radiation alone is not a promising process due to the fact that this polymer degrades during irradiation due to HCl evolution. It was found that the incorporation of difunctional monomers, such as ethylene glycol dimethacrylate or polyethylene glycol dimethacrylate, into the polymer allows one to accomplish the crosslinking process at drastically reduced radiation doses. In this manner, the side effect of HCl loss is avoided. The irradiation of polypropylene results in crosslinking only at very high doses due to the fact that polypropylene is quite sensitive to main chain scission under radiation conditions. The investigation indicates that the use of diallyl itaconate or triallyl cyanurate allows one to perform the desired crosslinking process at lowered doses and to avoid the problem of main chain scission. (auth)

30715 (NYO-9516) SYNTHESIS OF SEMICONDUCTOR MATERIALS BY RADIATION INDUCED REACTIONS. Quarterly Status Report No. 8, February 1, 1961—April 30, 1961. Richard Goldman and Kalman Held (TRG, Inc., Syosset, N. Y.). Contract AT(30-1)-2392. 12p. (TRG-132-QTR-8)

In an effort to prepare silicon by a radiation-induced reaction, an attempt was made to decompose trichlorosilane in the presence of hydrogen. The samples which were heated at both 400 and 500°C for 24 hr periods exhibited no decomposition. Additional samples of this mixture were irradiated at 350°C for 24 hr for a total dose of 6.0×10^6 rad. No evidence of decomposition was found. Two samples of an argon and silane mixture were heated for $1\frac{1}{2}$ hr at 350°C. Two additional samples were irradiated at 350°C for $1\frac{1}{2}$ hr to a total dose of 3.75×10^5 rad. The results showed that the percentage of decomposition for both thermal and thermal plus irradiation experiments is neither enhanced nor reduced by the presence of argon. Additional quantities of silane were prepared for future experiments. (M.C.G.)

30716 (SRO-52) RADIOCHEMISTRY OF ANTIMONY AND BISMUTH. Final Report. Harold C. Beard (Florida State Univ., Tallahassee). Aug. 1, 1961. Contract AT(38-1)-223. 31p.

A better quantitative analytical method was sought for the separation and identification of the cations of arsenic, antimony, and bismuth. This was accomplished by using the methods of complexation, solvation, and precipitation. All cations in HCl solution were reduced, the solution made 10N in HCl, and the arsenic extracted with benzene. The benzene layer, made 6N in HCl reduced the cation to metallic arsenic with sodium hypophosphite. The aqueous layer was oxidized and the antimony extracted with isopropyl ether. It was recovered from the ether layer by reduction which transferred it to the aqueous layer. The antimony was further reduced in HCl solution by chromous chloride to the metal. The aqueous layer from the isopropyl ether was made acid with HCl and the bismuth reduced with chromous chloride to the metal. It could also be determined as the quinolate. Distillation and sulfide precipitation were eliminated in this procedure and all cations were precipitated as the metals. Using As^{76}, Sb^{122}, and Bi^{210} the efficiency of the separations was determined. The separations was determined. The separated metals were identified by beta absorption measurements and half life determinations. Reproducibility was excellent and in both chemical and radiochemical determinations the deviations were not more than 2.0%. This is a clean, accurate, reproducible, and rapid method for the analytical radiochemical separation of arsenic, antimony, and bismuth. A comprehensive bibliography is appended. (auth)

30717 (UCRL-5882(Rev.)) CHEMICAL REACTIONS INDUCED BY UNDERGROUND NUCLEAR EXPLOSIONS. G. H. Higgins, D. E. Rawson, and W. Z. Wade (California. Univ., Livermore. Lawrence Radiation Lab.). June 30, 1961. Contract W-7405-eng-48. 31p.

As part of the general program for study of potential industrial and civil applications of nuclear explosions (Plowshare Program), chemical reactions useful for the recovery of nuclear energy are discussed. Three problems are considered. First, the mechanism for the transfer of explosive energy to the medium is discussed and the results of calculations of useful explosive energy in halite and NTS tuff are presented. Reactions above 2000°C have less than 10% thermal efficiency unless they can occur fast enough to be completed during the shock phase. Second, the cost of nuclear explosive heat derived from the service charges announced by the AEC is compared with the production site value of carbon fuel and electrical process heat. The explosive cost is found to compare favorably in a few cases only if the reactants can be found deeper than 2000 feet or the service charges for nuclear explosions announced by the AEC are reduced several fold. Third, information concerning the depth of occurrence, purity, and possible chemical reactions which might be induced by nuclear explosions is tabulated for about one-hundred minerals. Alunite, phosphorite, and trona appear to warrant further study. Since soluble products can in principle be formed from them, an economic advantage can be found through cheaper recovery methods even though heat costs are comparable. No discussion of recovery methods or costs is presented. (auth)

30718 (AEC-tr-4841) ADSORPTION OF Pu(IV) ON THE SURFACE OF GLASS. V. I. Grebenschikova and Yu. P. Davydov (Davidov). Translated by Martha Gerrard (Oak Ridge National Lab., Tenn.) from Radiokhimiya, 3: 165-72(1961). 12p.

The adsorption coefficient of Pu(IV) reaches a maximum

at pH = 3.0, after which it drops due to non-reversible adsorption of positively charged hydrolyzed Pu(IV) on the surface of solid admixtures in the solution and not by negatively charged, true Pu(IV) colloids. (R.V.J.)

30719 (CEA-tr-R-1359) POLYMERISATION DE L'ISOPRENE SOUS L'INFLUENCE DES RAYONNEMENTS. (Polymerization of Isoprene Under Influence of Radiation). V. S. Ivanov, M. A. Sokolova, S. V. Averyanov (Averjanov), V. F. Evdokimov, and I. S. Gurlyand (Gurljand). Translated into French from Vysokomolekulyarnye Soedineniya, 2: 35-7(1960). 11p.

Under the effect of Co^{60} γ radiation, isoprene is polymerized, and the polymer yield is directly proportional to the radiation dose if the intensity variations are slight. The microstructure of the polymer thus obtained does not depend on the dose, the radiation intensity, or the presence of a sensitizer. The mean molecular weight of the polyisoprene increases in proportion to the decrease of the radiation intensity. (tr-auth)

30720 PRELIMINARY STUDY ON THE CHEMICAL BEHAVIOR OF RECOIL NITROGEN-13. J. J. Point (Centre de la Faculte Polytechnique, Mons, Bel.). Bull. classe sci., Acad. roy. Belg., (5) 47: 123-33(1961). (In English)

After a discussion of the different possibilities for the study of the chemical behavior of recoil N^{13}, the data obtained on the chemical forms of N^{13} produced by (p,γ) or (d,n) reaction in alkaline carbonates or bicarbonates and in potassium ferrocyanide are discussed. (tr-auth)

30721 EFFECTS OF γ-RAY IRRADIATION ON FILAMENT OF ISOTACTIC POLYPROPYLENE. Ichiro Sakurada and Fujiko Kimura (Sakurada Lab., Japan). Bull. Inst. Chem. Research, Kyoto Univ., 39: 226-35(May 1961). (In English)

Studies were carried out on the effects of γ irradiation on the physical and mechanical properties of isotactic polypropylene filament. Samples were irradiated in the presence of air as well as in vacuo at room temperature. The densities of the samples were almost unchanged by irradiation in vacuo, but considerably increased in the case of irradiation in air. The degree of shrinkage at the flow temperature of the irradiated filament as well as the flow temperature decreased with increase in dose, except for a sample irradiated at a dose of 9.3×10^7 r in vacuo. The tensile strength and elongation at break decreased by irradiation in vacuo, especially in air. Young's modulus and elastic recovery at room temperature did not change with dose. The changes in these properties by irradiation are presumed to be dependent on the presence of oxygen. (auth)

30722 RADIATION CHEMISTRY OF HYDROCARBONS. II. BENZENE–CYCLOHEXANE. Tino Gäumann (Mellon Inst., Pittsburgh and Eidgenössische Technische Hochschule, Zurich). Helv. Chim. Acta, 44: 1337-49(1961). (In German)

The behavior of benzene and its mixtures with cyclohexane and iodine under the influence of ionizing radiation is examined. All the more important dimers are identified and a kinetic process for their formation is proposed. This process explains also part of the polymer production. Iodine does not act as a pure radical scavenger. It is shown that energy transfer between cyclohexane and benzene is much less important than was formerly believed. (auth)

30723 ISOTOPES AND RADIATIONS IN CATALYSIS. Paul Bussière (Centre National de la Recherche Scientifique, Paris). Inds. atomiques, 5: No. 5-6, 77-85(1961). (In French)

There are two types of catalysts—heterogeneous and homogeneous. In the study of both types, various utilizations of isotopes have permitted the data gained by other methods to be supplemented. Isotopes have assisted in the determination of the structural and textural problems of the masses in contact and in the resolution of the problems of chemical kinetics. Radiation chemistry offers possibilities for the improvement of the yields of catalyzed reactions. (J.S.R.)

30724 LITTLE KNOWN POSSIBILITIES FOR THE APPLICATION OF RADIATION ABSORPTION AND SCATTERING. H. Hart (Technische Hochschule für Chemie, Potsdam, Ger.). Isotopentechnik, 1: 143-4(May 1961). (In German)

A brief survey is given on the utilization possibilities of sealed radiation sources, with special consideration of the solution of analytical problems. (tr-auth)

30725 THE MEASUREMENT OF THE CONCENTRATION OF SOLUTIONS WITH β RADIATION. T. G. Neyman. Isotopentechnik, 1: 147(May 1961). (In German)

It is shown that both β absorption and back scattering can be used for chemical operational analysis. Details are given for the back scattering analysis. (tr-auth)

30726 THE INFLUENCE OF PHASE, TEMPERATURE AND BROMINE CONCENTRATION ON BROMINE PRODUCTION IN THE DECOMPOSITION OF CCl_3Br BY γ-RAYS. Richard F. Firestone and John E. Willard (Univ. of Wisconsin, Madison). J. Am. Chem. Soc., 83: 3551-54(Sept. 5, 1961).

The production of Br_2 by the radiolysis of CCl_3Br with Co^{60} γ rays was studied in the solid, liquid, and gas phases and as a function of temperature and bromine concentration. In the solid state at $-121°$ and below, the value of $G(Br_2)$ is 0.12 molecule produced/100 ev, independent of temperature. From -78 to 98° $G(Br_2)$ increases with temperature to about 3.5 with an apparent activation energy of about 2 kcal/mole. Although this activation energy suggests a diffusion controlled process, there is no change in $G(Br_2)$ or its temperature dependence on crossing solid phase transitions at -35.5 and $-13.5°$ or in going from the solid to the liquid state at the melting point $-5.6°$. Preliminary experiments indicate that there is no marked difference in yield in the gas phase as compared to the liquid phase at the boiling point. At bromine concentrations above about 0.01 M, $G(Br_2)$ is independent of bromine concentration at all temperatures in both the solid and the liquid. Below 0.01 M and at temperatures of 20° and above, however, $G(Br_2)$ decreases with increasing concentration. The bromine-sensitive reaction appears to have an activation energy of about 3 kcal/mole, slightly higher than the bromine insensitive reaction. The presence of oxygen raises $G(-CCl_3Br)$ several-fold, the production of Cl_2 (a minor radiolysis product) being increased by a larger factor than Br_2 production. (auth)

30727 HYDROGEN INHIBITION OF THE RARE GAS SENSITIZED RADIOLYSIS OF CYCLOPROPANE. C. F. Smith, B. G. Corman, and F. W. Lampe (Humble Oil and Refining Co., Baytown, Tex. and Pennsylvania State Univ., University Park). J. Am. Chem. Soc., 83: 3559-62(Sept. 5, 1961).

Argon, krypton, and xenon sensitize the gas-phase radiolysis of cyclopropane. Hydrogen also acts as a sensitizer but in moderate quantities inhibits the rare gas sensitization; in larger quantities, it inhibits its own sensitization. A sensitization and inhibition mechanism is proposed from which specific reaction rates for the radiolysis sensitization by argon and hydrogen are derived. (auth)

30728 THE OH YIELD IN THE Co^{60} γ RADIOLYSIS OF HNO_3. H. A. Mahlman (Oak Ridge National Lab., Tenn.). J. Chem. Phys., 35: 936-9(Sept. 1961).

The Co^{60} γ radiolysis on concentrated aqueous solutions was investigated and interpreted as the composite of two mechanisms: a molecular process $HNO_3 \rightsquigarrow HNO_3^* \rightarrow HNO_2 + \frac{1}{2} O_2$ and a radical process $HNO_3 \rightsquigarrow HNO_3^* \rightarrow OH + NO_2$. Designation of these mechanisms as molecular and radical is a consequence of the products detected. The existence of these two decomposition mechanisms was gleaned from the determination of the $G(H_2)$, $G(O_2)$, G_{OH}, $G(Ce^{3+})_{NoTl^+}$, and $G(Ce^{3+})_{Tl^+}$, and a comparison of these yields with those determined in comparable aqueous $NaNO_3$ solutions. The G_{OH} observed in HNO_3 solutions was found to be directly proportional to the HNO_3 concentration rather than a constant as was observed in comparable $NaNO_3$ solutions. The radical process is appreciable, increasing from 0 at zero HNO_3 concentration to 1.89 at 7 M HNO_3. The data present for the first time evidence of a direct effect upon concentrated aqueous nitrate solutions that is directly proportional to nitrate concentration. (auth)

30729 ISOTOPIC STUDIES INVOLVING FORMIC ACID AND ITS DERIVATIVES. VII. OXYGEN-18 ISOTOPE EFFECT IN THE PHOTOCHEMICAL REACTION OF FORMIC ACID WITH CHLORINE. Gus A. Ropp and W. A. Guillory (Oak Ridge National Lab., Tenn.). J. Phys. Chem., 65: 1496-8(Sept. 1961).

The oxygen-18 isotope effect on the rate of the photochemical reaction of formic acid with chlorine in the vapor phase was found to have a net value of $k_{16}/k_{18} = 1.002$ at 20°. It was concluded that abstraction of the hydroxyl hydrogen from formic acid by chlorine atoms makes no large contribution to the reaction mechanism. (auth)

30730 EFFECT OF SOLUTE CONCENTRATION ON THE RECOMBINATION OF H AND OH IN γ-IRRADIATED AQUEOUS SOLUTIONS. E. Hayon (Brookhaven National Lab., Upton, N. Y.). J. Phys. Chem., 65: 1502-5(Sept. 1961). (BNL-5207)

It is shown that on addition of high concentrations of inorganic solutes reactive to H atoms and OH radicals the recombination of H and OH to form water in γ irradiated aqueous solutions is reduced. The presence of 0.43 M Ce^{4+}, 0.1 M Tl^+ in 0.8 N H_2SO_4 solution increases G_{-H_2O} from 4.50 to 5.24. The yields of molecular hydrogen from air-free solutions of Ce^{4+} $-Tl^+$, Tl^+, Ce^{3+}, Br^- and arsenite were measured. $G_{H_2} \simeq 0.4$ in 0.8 N H_2SO_4 or HCl solutions as compared to ~0.45 for neutral Br^- and arsenite solutes. A mechanism is suggested which may explain the decrease in the molecular yield of hydrogen in acid solutions. (auth)

30731 RECOIL REACTIONS OF CARBON-11 IN n-HEXANE AND CYCLOHEXANE. Charles E. Lang and Adolf F. Voight (Ames Lab., Ames, Iowa). J. Phys. Chem., 65: 1542-6(Sept. 1961). (IS-269)

Cyclohexane and n-hexane were irradiated with x rays from a 47 Mev electron synchrotron to produce the reaction $C^{12}(\gamma,n)C^{11}$. The distribution of the recoil C^{11} in hydrocarbons of low molecular weight was studied using gas chromatographic separation with a scintillation counter monitoring the exit gas stream. Cyclohexane was irradiated at 30, 0, and −78° and n-hexane at 30°. The total C^{11} produced was determined by irradiating carbon under comparable conditions, burning it to CO_2, and measuring its activity in the same manner. Under most conditions acetylene−C^{11} was the most abundant radioactive product with up to 15% of the total C^{11} appearing in this form. Methane−C^{11} and ethylene−C^{11} were produced in 2 to 7% yield depending on conditions. Radioactive ethane, propane, and propylene were separated; 4-carbon compounds were observed as a group. Since the yield of C^{11} was small, no attempts were made to analyze for it in the parent compound or others of similar size. The results are discussed in terms of various mechanisms for recoil reactions. It appears that they can be explained on the basis of random fragmentation of the irradiated material by the very energetic C^{11} atoms and subsequent reactions of $C^{11}H_x$ radicals with these fragments. (auth)

30732 VAPOR PHASE γ-RADIOLYSIS OF ACETONE. Louis J. Stief and P. Ausloos (National Bureau of Standards, Washington, D. C.). J. Phys. Chem., 65: 1560-5 (Sept. 1961).

The effect of scavengers, pressure, temperature, and added xenon on the vapor-phase radiolysis of acetone-d_6 and acetone-acetone-d_6 mixtures was investigated. Most of the results can be explained on the basis of free radical reactions similar to those occurring in the photolysis of acetone-d_6. Values for the ratio of rate constants $k_1/k_2^{1/2}$ for the reactions $CD_3 + CD_3COCD_3 \rightarrow CD_4 + CD_2COCD_3$ and $CD_3 + CD_3 \rightarrow C_2D_6$ determined from the radiolysis data are in excellent agreement with values based on photolysis experiments, indicating that methane and ethane are formed by the reactions of thermalized methyl radicals. Methane and hydrogen formed in the presence of scavengers are mainly attributed to the occurrence of molecular elimination processes. (auth)

30733 HYDROGEN FORMATION IN THE RADIOLYSIS OF TOLUENE. R. B. Ingalls (Atomics International, Canoga Park, Calif.). J. Phys. Chem., 65: 1605-8(Sept. 1961).

The evolution of hydrogen from the radiolysis of liquid toluene, toluene-α,α,α-d_3, toluene-d_8, and equimolar solutions of pairs of these toluene analogs was studied. Results indicate that a disproportionately large fraction of the hydrogen gas evolved during radiolysis is from the hydrogen atoms of the methyl group, that a fraction of the gas is formed by an intramolecular process, and that some of the gas is formed by a bimolecular process other than abstraction from the methyl group. An interpretation based on free radical reactions is presented which accounts qualitatively for the data presented. (auth)

30734 INTRAMOLECULAR REARRANGEMENTS. II. PHOTOLYSIS AND RADIOLYSIS OF 4-METHYL-2-HEXANONE. P. Ausloos (National Bureau of Standards, Washington, D. C.). J. Phys. Chem., 65: 1616-18(Sept. 1961).

In the photolysis and radiolysis of 4-methyl-2-hexanone, three butene isomers are formed by an intramolecular rearrangement process in which a secondary or primary γ hydrogen is transferred to the carbonyl group. In the vapor phase photochemical decomposition, the ratios 1-butene/2-butene and cis-2-butene/trans-2-butene increase with decrease in wave length and increase in temperature. In the liquid phase photolysis, however, no dependence on wave length was observed, although the effect of temperature on the butene distribution was very pronounced. Similar results were obtained in the photochemical decomposition of sec-butyl acetate. In the transition of the liquid to the solid phase there was a drastic change in the butene distribution. The butene distribution obtained in the photosensitized decomposition at 2537 Å agrees closely with the one obtained in the non-sensitized decomposition at the same wave length. A comparison of the results obtained in the photolysis with those obtained in the radiolysis in the vapor and liquid phase indicates that in the latter case the butenes may be formed by way of a highly electronically excited molecule. (auth)

30735 E.P.R. OBSERVATION OF NH_3^+ FORMED BY X-RAY IRRADIATION OF AMMONIUM PERCHLORATE CRYSTALS. James S. Hyde (Varian Associates, Palo Alto, Calif.) and Eli S. Freeman. J. Phys. Chem., 65: 1636-8 (Sept. 1961).

The epr spectrum at room temperature obtained from a single crystal of irradiated ammonium perchlorate is shown. The spectrum is that expected from hyperfine interaction with one nucleus of spin 1 and three equivalent nuclei of spin 1/2. Contact with the nitrogen nucleus splits the spectrum into three lines of equal spacing and intensity, and contact with the three equivalent protons splits each of these three lines into a quartet of equally spaced lines with intensity ratios of 1 : 3 : 3 : 1. Several interesting observations were made concerning the anisotropy and temperature dependence. It is concluded that at 100° the NH_3^+ molecules rotate rapidly and the anisotropy which causes the difference in spectra found at lower temperatures is averaged out. The behavior of the anisotropy of the NH_3^+ resonance as a function of temperature suggests that freedom of the ion to rotate is frozen out in several fairly well-defined steps. The g-value of the center of gravity of the spectrum was found to be 2.0034 ± 0.0001. (P.C.H.)

30736 RADIATION INDUCED IONIC POLYMERIZATION OF BUTADIENE. Yoneho Tabata, Hiroshi Sobue, and Eisuke Oda (Tokyo Univ.). J. Phys. Chem., 65: 1645-7 (Sept. 1961).

The radioinduced polymerization of both liquid and solid butadiene was investigated in the temperature range −20 to −196°. Polymer samples in the temperature range gave almost identical infrared absorption spectra. It was estimated from the spectrum that 67% of the double bonds are due to trans-1,4-monomer units and 32% to vinyl groups. The radioinduced polymerization rate of the liquid monomer at relatively low temperatures increases with decreasing temperatures (activation energy = −0.4 kcal/mole), and indicates that the reaction proceeds by an ionic mechanism. On the other hand, the polymerization rate of the solid monomer decreases slightly with decreasing temperature (activation energy about 0.1 kcal/mole), which suggests that the liquid and solid state polymerizations have different propagation and termination mechanisms, even if the polymerizations proceed by the same ionic mechanism. It was concluded, though, that the solid state polymerization proceeds by an ionic mechanism. The polymerization of butadiene was not inhibited by oxygen or DPPH. (P.C.H.)

30737 OBSERVATIONS ON THE DECOMPOSITION OF X-RAY IRRADIATED AMMONIUM PERCHLORATE. Eli S. Freeman and David A. Anderson (Picatinny Arsenal, Dover, N. J.). J. Phys. Chem., 65: 1662-4(Sept. 1961).

By differential thermal analysis it was found that ammonium perchlorate sublimate exhibits decomposition characteristics similar to the irradiated sample. The exothermal reaction occurs prior to crystalline transition, but the reaction does not go to completion during the exotherm but at approximately 450°. The DTA decomposition pattern of irradiated ammonium perchlorate is similar in detail to that of the sublimate and of ammonium perchlorate containing ClO_3^- ion impurity. The presence of ClO_3^- in irradiated ammonium perchlorate was confirmed by the KI test, but it was not found to be present in the sublimate. It was concluded that if the mechanism of the decomposition of irradiated ammonium perchlorate below 300° involves ClO_3^- as an intermediate, then the role of ClO_3^- may principally be that of a source of radicals. (P.C.H.)

30738 ELECTRIC EQUIPMENT FOR RADIOCHEMICAL IRRADIATION SOURCES. [PART] I. Josef Simorda (Research Inst. in Plastic and Resin Tech., Gottwaldov, Czechoslovakia). Jaderná energie, 7: 272-80(1961). (In Czech)

A survey of various electric equipment, such as electron accelerators, x-ray equipment, uv sources, and electric discharge equipment used as radiochemical irradiation is given. Besides the description of the design and properties of particular equipment, attention is paid to technical and economic problems of irradiation with accelerated electrons. (auth)

30739 THE EFFECT OF IRRADIATION AND CHEMICAL PRETREATMENT ON THE THERMAL DECOMPOSITION RATE OF SILVER PERMANGANATE. V. V. Boldyrev, E. N. Pinaevskaya, A. V. Boldyreva, Yu. A. Zakharov, and V. P. Konyshev (Kirov Tomsk Polytechnic Inst., USSR). Kinetika i Kataliz, 2: 184-7(Mar.-Apr. 1961). (In Russian)

Preliminary irradiation of $AgMnO_4$ by Co^{60} γ rays and 200-kev x rays considerably increases the rate of thermal disintegration. The activation effects on the thermal decomposition can be explained by the radio induced formation of new phase regions. It is also shown that preliminary chemical treatment of $AgMnO_4$ with hydrogen sulfide and carbon oxide increases the rate of thermal decomposition. (tr-auth)

30740 ESR INVESTIGATIONS ON THE TRANSFER OF ENERGY TO AROMATIC GROUPS IN RADIOLYSIS OF CERTAIN ORGANIC COMPOUNDS. Yu. N. Molin, I. I. Chkheidze, N. Ya. Buben, and V. V. Voevodskii (Inst. of Chemical Physics. Academy of Sciences, USSR and Inst. of Chemical Kinetics and Combustion, Academy of Sciences, USSR). Kinetika i Kataliz, 2: 192-6(Mar.-Apr. 1961). (In Russian)

The efficiency of energy transfer in the radiolysis of frozen organic compounds of the AD type, where A is an aromatic energy acceptor and D is a radiative unstable replacer, was investigated. Electro paramagnetic resonance spectra and radical yields were used in evaluating energy transfer. Energy transfer in nonaromatic compounds was about twice that in aromatics, and the stability of the aromatic compounds increases with increased conjugation. (tr-auth)

30741 GAS CHROMATOGRAPHY IN CHEMICAL KINETICS STUDIES. CHROMATOGRAPHIC ANALYSIS OF ALKANE RADIOLYSIS PRODUCTS. V. G. Berezkin and L. S. Polak (Inst. of Petroleum-Chemical Synthesis, Academy of Sciences, USSR). Kinetika i Kataliz, 2: 285-91(Mar.-Apr. 1961). (In Russian)

Special features of chromotographic analyses of hydrocarbons were investigated, and a chromotographic installation suitable for two-step analysis is described. Chromotographic data on alkane radiolysis are included. (tr-auth)

30742 INFLUENCE ON IONIZING RADIATION ON CATALYTIC AND MAGNETIC PROPERTIES OF TITANIUM DIOXIDE. V. A. Mishenko, G. K. Boreskov, V. B. Kazanskii, and G. B. Parijskii (Karpov Inst. of Physics and Chemistry, USSR). Kinetika i Kataliz, 2: 296(Mar.-Apr. 1961). (In Russian)

Radiation effects were studied in relation to isotopic exchange between deuterium and hydrogen. Magnetic properties were investigated by electron paramagnetic resonance. Specimens of TiO_2 preheated at 500°C and 10^{-5} mm mercury for several hours before exposure showed little catalytic activity at 0°C. TiO_2 irradiated with Co^{60} γ rays at 120 r/sec to an integral dosage of 1.7×10^7 r at liquid nitrogen temperature showed a considerable increase in catalytic activity. (R.V.J.)

30743 IRRADIATION OF PHOSPHONITRILIC CHLORIDES. PART I. IRRADIATION OF LOWER HOMO-

LOGUES. M. W. Spindler and R. L. Vale (Wantage Research Lab., Berks, Eng.). Makromol. Chem., 43: 231-6 (1961). (In English)

The irradiation of trimeric and higher molecular weight linear and cyclic phosphonitrilic chlorides is described using 4 Mev electrons from a linear accelerator. The yields of polymer obtained under a variety of conditions, in the presence and absence of oxygen, are given. The changes in the infrared spectrum following irradiation indicate the presence of phorphorus–oxygen–phosphorus bonds in the polymers. It is found that the cyclic polymers are radiation stable in accordance with their aromatic character whereas the linear polymers and phosphonitrilic chloride gel are more sensitive to ionizing radiation. (auth)

30744 IRRADIATION OF PHOSPHORNITRILIC CHLORIDES. PART II. RADIATION INDUCED GRAFT COPOLYMERIZATION. M. W. Spindler and R. L. Vale (Wantage Research Lab., Berks, Eng.). Makromol. Chem., 43: 237-41(1961). (In English)

A series of graft copolymers of styrene and phosphonitrilic chloride rubber were prepared using Co^{60} γ radiation to initiate the polymerization. The degree of swelling of the copolymers in benzene is given and observations on their stability to water. (auth)

30745 ELECTRON SPIN RESONANCE OF γ-IRRADIATED ADIPIC ACID. J. R. Morton and A. Horsfield (National Physical Lab., Teddington, Middx., Eng.). Mol. Phys., 4: 219-23(May 1961).

The radical $(CO_2H)\dot{C}H(CH_2)_3(CO_2H)$ was detected in a γ-irradiated single crystal of adipic acid. It was calculated from the anisotropy of the spectra on rotation of the crystal that the radicals have almost the same orientation as the undamaged molecules, although the plane of the free radical carbon is twisted approximately 10° from the original plane of the three terminal carbon atoms. (auth)

30746 IRRADIATION DECOMPOSITION OF CARBON DIOXIDE. T. B. Copestake and N. S. Corney (General Electric Co., Ltd., Wembley, Middx., Eng.). Nature, 191: 1192(Sept. 16, 1961).

Samples of carbon dioxide received a thermal neutron dose of 2.3×10^{18} n cm^{-2}. Four general conclusions were drawn from the results: the decomposition by irradiation of carbon dioxide in the absence of an oxygen acceptor is extremely small; an increase in the surface area of the silica as effected by the introduction of silica wool into the vessels does not increase the efficiency of carbon monoxide production (the G_{CO} value); an increase in the carbon dioxide pressure up to 9.5 atm at 100°C does not cause a major change in G_{CO}; and there is always a deficiency of oxygen compared with the carbon monoxide formed. (P.C.H.)

30747 RADIATION-INDUCED FORMATION AND REACTIONS OF THE FORMYL RADICAL ION. John Holian, George Scholes, and Joseph J. Weiss (King's Coll., Newcastle-upon-Tyne, Eng.). Nature, 191: 1386(Sept. 30, 1961).

Some direct proof for the presence of CO^- in aqueous solutions was obtained from experiments in which oxygen-free aqueous solutions containing suitable organic solutes were irradiated in the presence of carbon monoxide. In certain cases the CO^- ion (or the COH radical respectively) can be combined with an organic radical with the formation of the corresponding formylated compound. The irradiation of aqueous solutions of methanol (10^{-1} M) in the presence of carbon monoxide (1 atm) with Co^{60} γ rays gave glycolaldehyde with a yield of G = 0.2 (molecules/100 ev) at pH = 5.4. It is important that the reaction is carried out in deoxygenated solutions. In general, the formylation process depends on the formation of a free radical from the organic solute by the action of the radiation-produced OH or (H_2O^+). (P.C.H.)

30748 DISSOCIATIVE ELECTRON CAPTURE IN WATER VAPOR. G. S. Hurst, L. B. O'Kelly, and T. E. Bortner (Oak Ridge National Lab., Tenn.). Phys. Rev., 123: 1715-18(Sept. 1, 1961).

An electron swarm experiment was conducted to study the process of negative-ion formation in water vapor by dissociative electron capture. Assuming that electrons are captured in a single process at one well-defined energy, the present results are consistent with a beam experiment reported by Buchel'nikova. It was found that the capture cross section, (due to the formation of H^-), when integrated over energy, was 7.7×10^{-18} cm^2 ev, which is consistent with the electron beam results of 6.5×10^{-18} cm^2 ev. The energy at which the process peaks was found to be 6.4 ev, which agrees quite well with the peak energy found by Buchel'nikova, but in general disagrees with other values obtained by mass spectroscopy. (auth)

30749 RADIATION-ENHANCED HELIUM PRECIPITATION IN COPPER. A. N. Goland (Brookhaven National Lab., Upton, N. Y.). Phil. Mag. (8), 6: 189-93(Feb. 1961). (BNL-4866)

The effect of neutron irradiation on the precipitation of helium atoms in copper was studied at temperatures up to 425°C. At 160 and 300°C no effect was observed. At 425°C the irradiated sample exhibited considerable precipitation around grain boundaries as compared to an unirradiated sample held at the same temperature. It was concluded that the additional vacancies introduced during the irradiation enhance the precipitation process. The resultant voids were equal in size to those obtained at higher temperatures in the absence of radiation. (auth)

30750 DISTILLATION OF I-132 FROM TELLURIUM-132 AND ITS APPLICATION. S. Popović, O. Miočka, A. Meniga, and I. Šimonović (Radioisotope Department of the Orthopedic Clinic, Zagreb). Primena Radioaktiv. Izotopa i Joniz. Zračenja u Med., 1: No. 2, 72-7(Dec. 1960). (In Yugoslavian)

The preparation of I-132 by distillation of Te-132 is described. Details are given on the construction of the apparatus, distillation procedures, with particular reference to parity, and the technique of uptake measurements in patients. (tr-auth)

30751 THE PROTON IRRADIATION OF METHANE, AMMONIA, AND WATER AT 77°K. Rainer Berger (Convair Scientific Research Dept., San Diego, Calif.). Proc. Natl. Acad. Sci. U. S., 47: 1434-6(Sept. 1961).

Experiments were undertaken to see if complex organic compounds could be synthesized in frozen mixtures of gases. Protons were chosen to supply the energy because 85% of cosmic radiation is composed of these particles. It was found that urea, acetamide, and acetone are obtained by radiation synthesis under conditions likely to be encountered in space. The number of proton impacts per cm^2 in the experiment approaches the order of magnitude of those sustained by a comet of the age of the solar system. (P.C.H.)

30752 SORPTION OF RADIOELEMENTS FROM SOLUTIONS. I. SORPTION OF Ag^{110}, P^{32}, AND Zr^{95} ON FLUORINATED GLASS SURFACE. I. E. Starik and N. G. Rozovskaya. Radiokhimiya, 3: 144-9(1961). (In Russian)

The sorption of silver, phosphorus, and zirconium from nitric acid media on chemically untreated glass and on HF etched glass was studied. It is shown that hydrofluoric acid reduces the sorptive ability of glass for Ag^+ and HPO_4^{2-}. A reduced negative charge resulting from hydroxyl group re-

placement by fluorine ions caused the reduced Ag^+ sorption, while for HPO_4^{2-} it is caused by the removal of metal cations from the upper layer of the glass. It is also shown that at 0.1 to 0.5n HNO_3 the sorption of zirconium on fluorinated glass is equal or in some cases greater than on untreated glass. (R.V.J.)

30753 CHEMICAL CHANGES IN β-DECAY OF RaD IN THE RADICAL DEFICIENT LEAD DERIVATIVES. V. D. Nefedov, V. L. Bykhovtsev, Chi-lan Wu, and S. A. Grachev. Radiokhimiya, 3: 225-36(1961). (In Russian)

It was found that chemical changes in the β decay of central (RaD) atoms in organic lead derivatives $RaDPh$, $RaDPh_3Cl$, and $RaDPh_2Cl_2$ take place without involving the surrounding molecules. Various processes taking place during the analysis of the daughter products and leading to redistribution of the daughter atoms between various elements are studied. (R.V.J.)

30754 EFFECTS OF γ-RAYS ON THE CATALYTIC ACTIVITY OF COPPER OXIDES IN THE REACTION OF DEHYDROGENATION OF ETHYL ALCOHOL. T. V. Tsetskhladze and G. Sh. Kalandadze. Trudy Inst. Fiz., Akad. Nauk Gruzin. S.S.R., 6: 61-8(1958). (In Russian)

The dependence of Cu_2O and CuO catalytic activity on radiation dose received is investigated in the dehydrogenation of ethyl alcohol. Irradiation induces an increase in CuO activity and a decrease in Cu_2O activity. Deuteroalcohol was produced to elucidate the mechanism of dehydrogenation. The isotopic composition of hydrogen produced in the dehydrogenation of this deuteroalcohol was studied. The measurements show the presence of a carbonyl mechanism, but do not exclude the enol one. Irradiation of the catalyst does not change the mechanism of the reaction. (auth)

30755 MANUFACTURING α- AND β-SOURCES FOR GRADUATION OF DOSIMETRIC APPARATUS. P. N. Vyugov, K. S. Goncharov, and V. S. Dementii (Inst. of Physics and Tech., Academy of Sciences, USSR). Ukrain. Fiz. Zhur., 6: 284(Mar.-Apr. 1961). (In Ukrainian)

The preparations of α and β sources from $UO_2(NO_3)_2 \cdot 6\,H_2O$ is described. Source intensities reached 220 to 250 α particle/xv $\cdot$ cm^2, which is satisfactory for calibration standards. (R.V.J.)

30756 RADIOLYSIS OF AQUEOUS URANIUM(IV) AND IRON(II) SULFATE SOLUTIONS AT ELEVATED TEMPERATURES. V. G. Firsov and B. V. Ershler (Belorussian State Univ., USSR). Zhur. Fiz. Khim., 35: 1887-9(Aug. 1961). (In Russian)

The rate of U(IV) oxidation in radiolysis at 270 to 310°C is nearly equal to that of Fe(II), confirming the postulation on participation of H atom in oxidation at elevated temperatures. (R.V.J.)

30757 EXPERIMENTAL NUCLEAR CHEMISTRY. Gregory R. Choppin. Englewood Cliffs, N. J., Prentice-Hall, Inc., 1961. 234p.

The basic knowledge needed to detect and measure radioactivity is presented and is illustrated by examples. A diversity of experiments is given to cover many fields of interest, and the experiments are of the type that may be tried within a three hour laboratory period. The experiments are of a physical, chemical, and analytical nature. (N.W.R.)

30758 CATALYTIC CONVERSION OF ORGANIC COMPOUNDS USING PENETRATING RADIATION. J. M. Caffrey, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,002,910. Oct. 3, 1961.

A method of hydrogenating an olefinic hydrocarbon by irradiating a substrate catalyst and increasing its catalytic activity is described. Ferric oxide with about 0.005% by weight of at least one oxide of a metal selected from the group consisting of aluminum, magnesium, nickel, zirconium, and manganese incorporated therein is irradiated. Then an alkane is placed upon the surface of the catalyst and irradiated in an atmosphere of hydrogen. Any olefin produced from this radiolysis becomes hydrogenated. (AEC)

30759 RADIOLYSIS OF ORGANIC COMPOUNDS IN THE ADSORBED STATE. J. W. Sutherland and A. O. Allen (to U. S. Atomic Energy Commission). U. S. Patent 3,002,911. Oct. 3, 1961.

A method of forming branch chained hydrocarbons by means of energetic penetrating radiation is described. A solid zeolite substrate is admixed with a cobalt ion and is irradiated with a hydrocarbon adsorbed therein. Upon irradiation with gamma rays, there is an increased yield of branched and lower molecular straight chain compounds. (AEC)

Raw Materials and Feed Materials

30760 (IDO-14430(Del.)) TECHNICAL PROGRESS REPORT FOR OCTOBER-DECEMBER 1957, IDAHO CHEMICAL PROCESSING PLANT. C. E. Stevenson (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Feb. 14, 1958. Decl. with deletions Feb. 25, 1960. Contract AT(10-1)-205. 78p.

A summary of plant operating experience is presented, and studies conducted in connection with plant process operations are reported. Dissolution studies were made on Al alloys, and a dissolution-extraction process was developed for separating U from Al alloys. Studies were made on Zr dissolution and extraction in Zr fuel processing. The development of the fluid bed calcination process for aluminum nitrate wastes was continued. Exploratory tests were made on the separation of Al and Zr from wastes. Various analytical methods are presented for such elements as B, U, Nb, Ca, and Gd. (D.L.C.)

30761 (NLCO-831) EFFECTS OF FURNACE PRESSURE AND FEED MATERIAL ON URANIUM INGOT QUALITY. Henry M. Eikenberry, Robert B. Steck, and Donald DeTrou (National Lead Co. of Ohio, Cincinnati). Dec. 1, 1960. Contract AT(30-1)-1156. 45p.

The uranium remelt operation at National Lead Company of Ohio is performed in a vacuum induction furnace at pressures ranging from 10^{-1} mm to 5×10^{-1} mm Hg (ionization gage readings). A program was originated to determine the effect of furnace pressure on ingot chemical impurities and metallurgical qualities. A series of melts (69) was made under controlled conditions at furnace pressures of 350, 30, 3, and less than 3×10^{-1} mm Hg. All ingots were cast in heated graphite molds. A mercury switch, incorporating a manometer and electrical relay system, was designed to serve as a pressure indicator and automatic controller. A comparison of hydrogen, oxygen, carbon, and nitrogen concentrations in preselected areas within the ingots demonstrated that these concentrations as well as core-to-good-core yield were affected by the furnace operating pressure. Forty-two additional ingots were vacuum-melted and cast to determine the joint effect of feed material and pressure on hydrogen, oxygen, carbon, and nitrogen concentrations. In this phase of the program, furnace pressures of 33, 3, and less than 3×10^{-2} mm Hg were used. Furnace charges consisted of two types of feed material. A joint effect of feed material and furnace pressure on hydrogen and carbon

concentrations, and a joint effect of feed material and sample location (top versus bottom) on oxygen and nitrogen concentrations were detected. A study was also made of the change in hydrogen concentration in the processing of ingots to fuel cores. Significantly more hydrogen was detected in the fuel cores. (auth)

30762 (NP-10780) MONTHLY REPORT [OF] DEVELOPMENT, AUGUST 1961. (Eldorado Mining and Refining Ltd. Research and Development Div., Ottawa). 20p. (RD-61-8).

A summary is given of the results of atmospheric carbonate leach tests. Batch and bench-scale tests were made for continuous precipitation of pregnant solutions containing 10 g/l $NaHCO_3$, using the precipitate recycle technique. The equilibrium characteristics of General Mills quaternary amine sulfate with a synthetic pregnant solution of low carbonate, bicarbonate, and sulfate concentrations were established. Analytical results of raffinate and extract for five uranium extraction isotherms are tabulated, and the resulting curves are shown. Surfactant studies were made of the emulsion tendencies of a slurry feed of Port Radium Gravity concentrates. The use of excess phosphate ions in the extraction process was studied for thorium control. Metal development work was continued for: preparation of aluminum–25.9% uranium alloys; vacuum melting; NRX and NRU production rods; preparation of uranium powder; and magnesium reduction of uranium oxides. Ceramic UO_2 development studies are discussed for: electrical conductivity measurements, and production of fused UO_2; and conversion of UF_6 to UF_4. Investigations are discussed for: dissolution techniques for uranium steel; soluble uranyl carbonates in the Beaverlodge process; removal of impurities from Beaverlodge precipitates; and scandium analyses. (B.O.G.)

30763 DISSOLUTION OF U_3O_8 IN SULFURIC ACID. I. ON THE KINETICS OF REACTIONS WITH POWDERS. V. M. Solntsev and Yu. M. Tolmachev. Radiokhimiya, 3: 187-94(1961). (In Russian)

A formula is derived for calculating the reaction rate constant for a powder of various size particles. A more generalized equation, than the Iandes equation, is developed for monodispersed powder reaction in the diffusion region. It was established that the dissolution of mixed uranium oxides in concentrated sulfuric acid solutions comply with the equation $m_0^{1/3} - m^{1/3} = Zt$. (R.V.J.)

30764 PLUTONIUM DIOXIDE REACTION WITH WATER FREE ACID AMMONIUM FLUORIDE. Ya. Maly, I. Peka, M. Talash, and M. Tympl. Radiokhimiya, 3: 195-8(1961). (In Russian)

A new method is suggested for preparing PuF_4 by fluorinating PuO_2 with water-free NH_4HF_2. The thermal stability and structure of intermediate compounds and finite product are analyzed. (R.V.J.)

Separation Processes

Refer also to abstract 30344

30765 (BM-RI-5862) SEPARATION OF TANTALUM FROM COLUMBIUM BY THE HYDROFLUORIC ACID–SULFURIC ACID–METHYL ISOBUTYL KETONE SYSTEM. S. L. May, J. L. Tews, and T. N. Goff (Bureau of Mines. Albany Metallurgy Research Center, Ore.). May 31, 1960. 36p.

It is demonstrated that high-purity niobium and tantalum compounds can be obtained by application of the solvent extraction system hydrofluoric acid–sulfuric acid–methyl isobutyl ketone. Design of equipment and operating conditions are discussed. (L.T.W.)

30766 (HW-39938) INVENTION DESCRIPTION–DEVISES FOR IMPROVING THE EFFICIENCY OF SEPARATION IN PULSED LIQUID-LIQUID EXTRACTION COLUMNS. O. H. Koski (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 15, 1955. Contract W-31-109-Eng-52. 7p.

The use of preferentially organic-wet interplate packings or specially designed mechanical inserts to improve the operating efficiency of pulsed countercurrent liquid-liquid extraction columns is described. A method which proposes packing chosen interplate spaces with materials which are wet by the organic phase preferentially to the aqueous phase is discussed. With tight packing, alternation of continuous and dispersed phases is achieved. With loose packing or certain configurations of packing, complete disengaging and by-passing of the two phases without formation of a continuous organic phase will occur. (M.C.G.)

30767 (IDO-14410(Del.)) TECHNICAL PROGRESS REPORT FOR JANUARY–MARCH 1957, IDAHO CHEMICAL PROCESSING PLANT. C. E. Stevenson (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). July 18, 1957. Decl. with deletions Feb. 25, 1960. Contract AT(10-1)-205. 95p.

Plant experience in processing aluminum alloy by batch dissolving and Hexone extraction, and startup and initial operation of the Zr alloy head-end process are described. Results obtained in Ba^{140} recovery are summarized. Satisfactory decontamination and excellent recovery of the U from irradiated Zr alloy was achieved. The corrosion of Ti was shown to be low in nitric-hydrochloric acid mixtures useful for fuel dissolving. Ti also withstood the action of most decontaminating reagents. Laboratory studies of fission product volatilization in the high temperature decomposition of aluminum nitrate indicated that only Ru was volatilized significantly from aged wastes. Studies of pneumatic transportation of alumina particles yielded correlation of pressure drop with solids flow rate. Solids velocity was essentially independent of solids loading, but proportional to air velocity, over useful operating ranges. Studies of the corrosion of materials which might be used for calciner construction indicated negligible corrosion of Carpenter-20 and Type 347 stainless steel for exposures of the order of 400 hours. Carbon steel showed some tuberculation and oxidation when used to transfer heat to the fluid bed. The thermal conductivity of calcined alumina was found to range from 0.08 Btu/(hr)(ft)(°F) at room temperature to 0.23 at 1000°F. Further studies of a three-beam spectrophotometer for the continuous determination of uranyl nitrate in aluminum nitrate-nitric acid solutions continued to demonstrate the feasibility of such an instrument. Mechanical construction of a test model is nearly complete. Correlation of absorption coefficients with solution concentrations indicated that both aluminum nitrate and nitric acid could be simultaneously determined (over the 0.5 – 1.5M concentration range) with sufficient accuracy to be of value in certain applications. Studies of the low frequency (1000 cycle) and high frequency (250 megacycle) conductivity of nitric acid-aluminum nitrate solutions indicated that this property could be used to measure the acid content continuously. High frequency measurements using a transmission line oscillator appeared to be more favorable for instrument development since electrodes are not required. Preliminary investigation of emission spectroscopy for determining the isotopic distribution of U indicated that reasonable accuracy could be obtained with a high resolution instrument. (auth)

30768 (NYO-9173) THE DECONTAMINATION AND RECOVERY OF PRECIOUS METALS. Quarterly Progress Report, July 2, 1960 to October 1, 1960. (Nuclear Materials and Equipment Corp., Apollo, Penna.). Contract AT (30-1)-2528. 45p.

Surface Decontamination. Experiments on the decontamination of Pt by fused salts, acids, and controlled solution using aqua regia are reported. Decontamination by Solvent Extraction. Experiments were performed which show the method of Pt-Sn complex extraction by ethyl acetate to be effective in decontaminating a Pt crucible contaminated with Co^{60}. Scale-up of the method for industrial application is discussed. Chemical Analyses. Results are presented for the spot test paper x-ray fluorescence method for analysis of Pd, Pt, and Au solutions for precious metal traces. The sensitivities of the method were determined. Increase of the accuracy of the method by concentration was investigated. Trace analysis by emission spectrography was studied by conducting experiments on the vacuum cup technique with Au, Pd, and Pt matrices and on the flat top electrode technique with Pt. (D.L.C.)

30769 (NYO-9578) ULTRASONIC FUEL REPROCESSING MERCURY. W. B. Tarpley and C. D. McKinney, Jr. (Aeroprojects, Inc., West Chester, Penna.). Mar. 1961. Contract AT(30-1)-1836. 44p.

The introduction of vibratory motion at ultrasonic frequency into the corrosive, high-temperature, pressurized and radioactive environment, encountered in the reprocessing of fuel elements in liquid mercury system has led to significant improvement in dissolution rates. Laboratory-scale (7 kg) studies of Th dissolution indicate rate increase in excess of 1500 fold through activation of the gel-like mercuride surface film. Stainless steel and Zircaloy-2 cladding which are normally unaffected by mercury were ultrasonically eroded at low but usable rates of about 0.1 $mg/cm^2/hr$ and 1.0 $mg/cm^2/hr$, respectively, at the mercury boiling point. Ultrasonic mixing of mercury immiscible phases was accomplished with 15-fold increases in quantity extracted over that extracted in nonultrasonic control runs. Ultrasonic vibration will induce "shear thinning" and promote the flow of thixotropic mercury amalgams. (auth)

30770 (ORNL-3153) CHEMICAL TECHNOLOGY DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING MAY 31, 1961. (Oak Ridge National Lab., Tenn.). Sept. 21, 1961. Contract W-7405-eng-26. 167p.

Activities in research programs are summarized in the areas of power reactor fuel processing, fluoride volatility processing, molten salt reactor fuel processing, homogeneous reactor fuel processing, waste treatment and disposal pilot plant decontamination, GCR coolant purification studies, equipment decontamination, HRP thoria blanket development, fuel cycle development, transuranium element studies, production of U^{232}, uranium processing, fission product recovery, thorium recovery from granite, solvent extraction technology, mechanisms of separation processes, radiation effects on catalysts, ion exchange technology, chemical engineering research, chemical applications of nuclear explosions, reactor evaluation studies, and assistance programs. (J.R.D.)

30771 (TID-13864) SOLVENT EXTRACTION STUDIES. Terminal Report. C. Gerald Warren (Western State Coll. of Colorado, Gunnison). Sept. 1961. Contract AT(11-1)-749. 15p.

Hydrogen 2-ethylhexyl phenacylphosphonate was prepared by a hydrochloric acid catalyzed hydrolysis of bis(2-ethylhexyl) phenacylphosphonate. Although various samples of the liquid product possessed different refractive indexes and densities, the agreement of their molar refractivities with the theoretical value indicated that the structure of the various products was similar to the theoretical structure. There was also some variation in the chemical properties of the different samples. The reaction between the various forms of the compound and lanthanum (III) was established by solvent extraction techniques. Three molecules of the stable form of HEhPP were used in the extraction of lanthanum. Other forms of HEhPP gave different extraction reactions and were unstable. (auth)

30772 (AEC-tr-4840) EXTRACTION OF RUTHENIUM AND SOME OTHER FISSION PRODUCTS BY TRI-n-OCTYLAMINE FROM NITRIC ACID SOLUTIONS. V. B. Shevchenko and V. S. Shmidt. Translated by Martha Gerrard (Oak Ridge National Lab., Tenn.) from Radiokhimiya, 3: 121-8(1961). 14p.

The extraction of Cs^{137}, Ce^{144}, Sr^{90}, Zr^{95} + Nb^{95}, and Ru^{106} from nitric acid solutions by tri-n-octylamine (TOA) was studied. It was found that only ruthenium could be extracted by TOA and the best conditions for extraction are examined. (R.V.J.)

30773 SEPARATION OF THE LANTHANONS AT AMALGAM CATHODES. MEASUREMENT OF THE SEPARABILITY OF PRASEODYMIUM AND NEODYMIUM IN AQUEOUS LITHIUM CITRATE ELECTROLYTES. E. I. Onstott (Los Alamos Scientific Lab., N. Mex.). Anal. Chem., 33: 1470-3(Oct. 1961).

The separability of Pr and Nd by electrolysis at amalgam cathodes was measured under controlled conditions of temperature, electrolyte composition, and current density. Separability increased with increasing concentration of Pr + Nd in the electrolyte and was highest at low current density. The Pr/Nd ratio in the amalgam was as high as 3.3 for electrolyte containing 0.2M Pr and 0.2M Nd. For a given concentration of Pr + Nd in the electrolyte, the separation factor did not change much when the Pr/Nd ratio in the electrolyte was varied from 0.1 to 10. La or Gd in the electrolyte did not lower the separation factor. (auth)

30774 THE EFFECT OF ORGANIC SUBSTITUENTS AND STRUCTURE OF ORGANOPHOSPHORUS COMPOUNDS ON THEIR EXTRACTION ABILITIES FOR URANIUM. Shinzo Normura and Reinosuke Hara (Japan Atomic Energy Research Inst., Tokyo). Anal. Chim. Acta, 25: 212-18 (Sept. 1961). (In English)

With 12 phosphates, 1 phosphonate, 1 phosphinate, and 1 phosphine oxide, the pattern of uranium extraction from nitric acid media was investigated. The extraction was affected by the nature of the organic substituents attached to the phosphoryl group as well as by the solvent structure. Phosphates with aryl groups were not satisfactory extractants. The extraction ability increased as the alkyl group was made larger; phosphates with branching alkyl groups were better than phosphates with normal alkyl groups. Removal of the alkoxyl oxygen enhanced the extracting abilities. The relative order of the extracting abilities were: tri-n-butyl phosphine oxide and tri-n-butyl phosphinate > tricyclohexyl phosphate > diethylbutyl phosphonate > phosphates with branching alkyl groups > phosphates with normal alkyl groups > phosphates with aryl groups. (auth)

30775 SEPARATION OF URANIUM BY ANION EXCHANGE. F. Tera and J. Korkisch (Universität, Vienna). Anal. Chim. Acta, 25: 222-5(Sept. 1961). (In English)

A method for the separation of uranium(VI) from numerous elements by means of anion exchange is described; the negatively charged chloride complex of uranium is adsorbed on the strongly basic anion exchanger Dowex IX8

(chloride form) from a solution containing 80% methanol and 20% 6N hydrochloric acid. The uranium was determined by a polarographic method based on the catalytic nitrate wave of uranium. (auth)

30776 RADIOCHEMICAL STUDIES ON THE SOLVENT EXTRACTION OF INORGANIC IONS WITH DODECYLBENZENESULFONIC ACID. II. INORGANIC EXTRACTION STUDIES ON THE SYSTEM DODECYLBENZENESULFONIC ACID–HYDROCHLORIC ACID. Tomitaro Ishimori (Japan Atomic Energy Research Inst., Tokyo), Eiko Nakamura, and Hiroko Murakami. J. At. Energy Soc. Japan, 3: 590-7(Aug. 1961). (In English)

A radiochemical study on the extraction behavior of about sixty chemical elements was performed in 3% DBSA, 1 : 1 diethyl ether ethyl acetate mixture, and hydrochloric acid solution system. The distribution ratios between organic and aqueous phases were determined in the acidity range 0.01 to 2.0 N hydrochloric acid. The characteristics of the acid dependence curves; DBSA extraction gives different K_d values depending on the valency of the inorganic cation to be extracted, DBSA is of no use for anion extraction, and K_d values in DBSA extraction are not so high or so low that determination of K_d values is easy; were definitely confirmed. In addition, the similarity between DBSA extraction and cation exchange was clarified. The usefulness of DBSA extraction in indicating the valency or ionic charge of inorganic cations in aqueous solution was clearly ascertained. (auth)

30777 EXTRACTION OF TRACER QUANTITIES OF URANIUM(VI) FROM NITRIC ACID BY TRI-n-BUTYL PHOSPHATE. Y. Marcus (Israel Atomic Energy Commission Labs., Rehovoth). J. Phys. Chem., 65: 1647-8(Sept. 1961).

The thermodynamic equation relating D_U, the distribution coefficient of uranium (VI) tracer between tri-n-butyl phosphate (TBP) in an inert diluent and nitric acid, to the concentrations of nitric acid and TBP, C_H and C_T, are evaluated quantitatively. The calculations describe the extraction of nitrates at tracer concentrations by TBP, and chemical reactions which describe the system in the range of 0 to 7 M nitric acid and 0 to 1 M TBP are given. The calculations are compared with experimental data. (P.C.H.)

30778 EXTRACTION OF U(VI) AND (IV) WITH DIISOAMYL ETHER OF METHYLPHOSPHONIC ACID FROM HYDROCHLORIC SOLUTIONS. V. B. Shevchenko, V. S. Shmidt, and E. A. Nenarokomov. Radiokhimiya, 3: 129-36(1961). (In Russian)

The mechanism of uranium(VI) and (IV) extraction with diisoamyl ether of methylphosphonic acid (DAMPA) from hydrochloric acids was studied. The stability of uranium extracted from hydrochloric solutions was analyzed. It was found that uranium(VI) is well extracted by 20% DAMPA into CCl_4 at acidity > 2n HCl, while uranium(IV) could be extracted by 20% DAMPA and TBP into CCl_4 only with concentration of HCl > 4 to 5n. It was established that U(VI) extracted with DAMPA at acidity up to 5n HCl appears as $UO_2Cl_2 \cdot 2DAMPA$ complex. The U(IV) is extracted by DAMPA as $UCl_4 \cdot 2DAMPA$ and by TBP as $UCl_4 \cdot 2TBP$. The ratio of stability constants for $UO_2Cl_2 \cdot 2DAMPA$ and $UO_2Cl_2 \cdot 2TBP$ is ~110 and for $UCl_2 \cdot 2DAMPA$ and $UCl_2 \cdot 2TBP$ ~300. (R.V.J.)

30779 EFFECTS OF SALTING-OUT ON URANYL NITRATE EXTRACTION BY CYCLOHEXANONE. S. Mints and A. Ugnevskaya. Radiokhimiya, 3: 137-43(1961). (In Russian)

The absorption spectra are given for uranyl nitrate aqueous solutions with various concentrations of $LiNO_3$, $NaNO_3$, NH_4NO_3, $Mg(NO_3)_2$, and $Ca(NO_3)_2$. The extinction coefficients for $UO_2(NO_3)_2$ at 404, 414, and 426 mμ are plotted as functions of concentration of the salting-out agent. The concentration of $[UO_2(NO_3)_2(H_2O)_2]$ was measured, and it was found that the equilibrium shift $[UO_2(H_2O)_6]^{2+} + 2NO_3^- \rightleftharpoons [UO_2(NO_3)_2(H_2O)_2] + 4H_2O$ is reduced in the order $Mg(NO_3)_2 > LiNO_3 > NH_4NO_3 > NaNO_3 > Ca(NO_3)_2$. Corresponding solutions of various salting-out agents were found on the basis of E = f(m) curves, and the curves of uranyl nitrate distribution coefficients between cyclohexane and water are plotted as functions of salting-out agent concentration. (R.V.J.)

30780 STUDIES OF PROTACTINIUM IN AQUEOUS SOLUTIONS. IV. ION EXCHANGE METHOD. I. E. Starik, L. D. Sheidina, and L. I. Il'menkova. Radiokhimiya, 3: 150-4(1961). (In Russian)

The dependence of Pa^{233} distribution on ion exchange resins on the concentration of HNO_3 (1 to 14n) indicates that protactinium appears as a complex ion of variable charge. The mean cation charge is 3, which corresponds to a maximum in HNO_3 (1 to 4n) solution. In > 5n nitric acid, protactinium forms various negatively charged complexes. The mean charge of Pa anions on resins (8 to 12n HNO_3) is 3. The probable maximum anion charge in HNO_3 solution is 3. (R.V.J.)

30781 VAPOR PRESSURE OVER URANYL NITRATE ETHER SOLUTION. V. M. Vdovenko, D. N. Suglobov, and L. G. Mashirov. Radiokhimiya, 3: 173-80(1961). (In Russian)

The vapor pressure over ether solutions of uranyl nitrate dihydrate was measured for various concentrations at 0.3, 15, 20, and 30°C, and activity coefficients of the salts in solution were calculated. The mean number of ether molecules bound with a salt molecule (n) was calculated on the basis of the pressure curve deflection from Rault's law. The relation of n to concentration is dependent on salt polymerization in the solution. A dimerization mechanism is suggested for describing the relation of vapor pressure to concentration up to a salt concentration of 2.5 mol/kg of solvent. Being endothermic, the dimerization reaction takes place at the expense of increased enthropy. (R.V.J.)

30782 PROCESS FOR SELECTIVE EXTRACTION OF NITRATES FROM AQUEOUS NITRATE-SULFATE SOLUTIONS. (to Rohm & Haas Co.). British Patent 878,244. Sept. 27, 1961.

A process is described for the extraction of nitrate from an aqueous acidic solution containing sulfate. The process consists of intimately contacting the solution with at least one water-insoluble amino compound in the liquid phase whereby the amino compound selectively extracts nitrate from the solution. A quaternary ammonium compound may be used instead of the amino compound. The compounds are a primary, secondary, or tertiary amine having a molecular weight of at least 185, the quaternary compound also has a molecular weight of 185. The amino compounds employed are dodecylbenzyl t-dodecylamine, dodecenyl t-dodecylamine, tridodecenylamine, or dodecylbenzyl di-n-butylamine. The quaternary compound is dodecenyl trimethyl ammonium chloride. This process has particular value in the cyclic uranium recovery process for decreasing cost by saving of the nitrate solutions. (N.W.R.)

30783 METHOD OF SEPARATING NEPTUNIUM BY LIQUID-LIQUID EXTRACTION. Donald F. Peppard and George W. Mason (to U. S. Atomic Energy Commission). U. S. Patent 3,004,823. Oct. 17, 1961.

A method of solvent extraction for neptunium values in solutions containing other actinide values and rare earth

values, using mono (2-ethylhexyl) orthophosphoric acid is described. (AEC)

30784 METHOD OF SEPARATING NEPTUNIUM. Glenn T. Seaborg (to U. S. Atomic Energy Commission). U. S. Patent 3,005,680. Oct. 24, 1961.

A process is described for separating neptunium from plutonium in an aqueous solution containing sulfate ions. The process consists of contacting the solution with an alkali metal bromate, digesting the resulting mixture at 15 to 25°C for a period of time not more than that required to oxidize the neptunium, adding lanthanum ions and fluoride ions, and separating the plutonium-containing precipitate thus formed from the supernatant solution. (AEC)

30785 SEPARATION PROCESS. Raymond W. Stoughton (to U. S. Atomic Energy Commission). U. S. Patent 3,005,681. Oct. 24, 1961.

A process for separating tetravalent plutonium from aqueous solutions and from niobium and zirconium by precipitation on lanthanum oxalate is described. The oxalate ions of the precipitate may be decomposed by heating in the presence of an oxidizing agent, forming a plutonium compound readily soluble in acid. (AEC)

30786 SEPARATION OF TECHNETIUM FROM AQUEOUS SOLUTIONS BY COPRECIPITATION WITH MAGNETITE. Stanley J. Rimshaw (to U. S. Atomic Energy Commission). U. S. Patent 3,005,683. Oct. 24, 1961.

A method of separating technetium in the 4+ oxidation state from an aqueous basic solution containing products of uranium fission is described. The method consists of contacting the solution with finely divided magnetite and recovering a technetium-bearing precipitate. (AEC)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

Refer also to abstract 31846

30787 (CF-61-3-129(Rev.1)) TrU FACILITY—ALPHA BOX ACCESSORIES—MANIPULATOR OPERABLE SPHERICAL JOINT CLAMP. B. B. Klima (Oak Ridge National Lab., Tenn.). July 22, 1961. Contract [W-7405-Eng-26]. 4p.

A special clamp has been designed and developed which is manipulator operable and which will clamp a standard spherical (glass) joint. This version of the clamp can be pre-adjusted to securely lock on the joint, owing to the incorporation of an adjustable seat for the over-center clamp. (auth)

30788 (HW-62091(Del.)) PLUTONIUM OXALATE DISK FILTER AND FILTER MEDIA STUDIES. George Rey (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 19, 1959. Decl. with deletions Sept. 27, 1961. 26p.

A disk type filter was developed and found feasible for filtration of plutonium oxalate slurries. A scalpel produces a slit in the filter precoat, leading to increased filtration in this slit, and the oxalate is removed by a doctor knife; this technique results in prolonged blowback cycles and more uniform delivery of filtered oxalate to subsequent processing steps. Several types of filter media were tested, and rigid porous aluminum oxide was found to be the best one. (D.L.C.)

30789 (NP-10797) ISOTENSOID PRESSURE VESSELS. John Zickel (Aerojet-General Corp., Sacramento, Calif.). [1961?]. 5p.

Presented at American Rocket Society Space Flight Report to the Nation, New York Coliseum, October 9-15, 1961.

Equations are developed for the cylindrical section and pressure vessel head of the isotensoid pressure vessel, which consists entirely of filaments loaded to identical stress levels. (B.O.G.)

30790 (RISÖ-26) RADIOISOTOPE LABORATORY DESIGN. K. Heydorn, K. A. Singer (Denmark. Atomenergikommissionen. Forsøgsinstitut, Risø), and J. Wangel (Copenhagen. Universitet. Rattsmedicinska Institutet). July 1961. 28p.

The basic requirements are described for radioisotope laboratories. The limitations imposed by practical and economic possibilities are considered. Practicable solutions to general problems encountered in almost any kind of radioisotope laboratory are presented, together with examples of solutions to more specific problems with particular reference to laboratories for medium high γ activities. (auth)

30791 (SC-4586(M)) 6-C MOTOR LOAD SIMULATOR. J. P. LaPoint (Sandia Corp., Albuquerque, N. Mex.). Sept. 1961. Contract AT(29-1)-789. 30p.

The 6-C Motor Load Simulator tests d-c relays of either the regular or latching type; the relays may have a maximum of six form C contacts. The relays may contain 24 to 30 volt coils and require up to a maximum of 1.0 ampere total coil current. The operating theory, a general description of the Simulator, and the operating procedure are given. (auth)

30792 (SCTM-131-61(25)) DUST MONITORING IN CLEAN ROOMS. (Sandia Corp., Albuquerque, N. Mex.). Aug. 1961. Contract [AT(29-1)-789]. 49p.

A compilation was made of the talks and reports presented at a Clean Room Monitoring Seminar held on March 28 and March 31, 1961, under the sponsorship of the Advanced Manufacturing Development Division, 2564. The over-all clean-room problem was studied with particular emphasis placed on developing an adequate system for the detection, measurement, and control of air-borne dust in clean rooms. Various attendant problems and their possible solutions are discussed. (auth)

30793 (SCTM-203-60(14)) A HIGH-VOLTAGE PULSE GENERATOR FOR TESTING DIELECTRIC SAMPLES. R. D. Kelly (Sandia Corp., Albuquerque, N. Mex.). July 13, 1960. Reprinted Aug. 30, 1961. Contract [AT-(29-1)-789]. 39p.

Problems inherent to general dielectric strength measurements are described and a guide in establishing methods for pulse dielectric strength measurements is presented. The shape of the test electrodes is investigated from a theoretical viewpoint, and the actual test electrode shape is evaluated. The detailed description of the laboratory techniques used in making accurate high-voltage pulse measurements is given in addition to a description of the high-voltage pulse generator. The results of some preliminary tests of the pulse dielectric strength of several types of coaxial cable are given to illustrate how the pulse generator can be used and how such tests are performed. (auth)

30794 (TID-13212) BEARINGS FOR OPERATION IN DRY HELIUM AT 520°F. Final Report. Jamshed B. Havewala (Marlin-Rockwell Corp., Jamestown, N. Y.). May 1, 1961. For Kaiser Engineers, Inc., Oakland, Calif. Contract AT(10-1)-925, Subcontract No. 5918-RD5. 88p.

Results are presented of research and development conducted to develop bearings to operate in helium cooled reactor mechanisms at 510°F. Data are discussed and it is concluded that continued investigation of bearing speed effects on dry film life is desirable. Investigations directed toward improving the treatment of bearing retainers, improved use of dry film, and modification of retainers to extend dry film life also appear desirable. (J.R.D.)

30795 (TID-13588) 60 CONDUCTOR HIGH TEMPERATURE-RADIATION RESISTANT FLEXIBLE CABLE. E. T. Parker (Physical Sciences Corp., Pasadena, Calif.). Mar. 28, 1961. Contract [AT(10-1)-925]. For Kaiser Engineers, Oakland, Calif. 38p.

The tests showed that the 60-conductor cable can withstand 17,500 flexures with a ±30° twist at 510°F with no measurable loss in insulation resistance and no gain in conductor resistance. The cable tested at 510°F showed some stiffening but remained flexible enough to easily bend over a 10 in. mandrel. There was no change in the flexibility of the cable tested at room temperature. (auth)

30796 (UCRL-9662) FORCE MULTIPLIER FOR USE WITH MASTER SLAVES. Leonard E. Miles, Thomas C. Parsons, and Patrick W. Howe (California. Univ., Berkeley. Lawrence Radiation Lab.). June 2, 1961. Contract W-7405-eng-48. 9p.

A force multiplier was designed. This piece of equipment

was made to increase the gripping force presently available in the Model 8 master slave. The force multiplier described incorporates a clamp which can be quickly attached to and detached from the master slave hand. (auth)

30797 (WADD-TR-60-699(Vol.VII)) ENERGY CONVERSION SYSTEMS REFERENCE HANDBOOK. VOLUME VII. HEAT EXCHANGERS. A. Haire and L. Hays (AiResearch Mfg. Co., Los Angeles and Electro-Optical Systems, Inc., Pasadena, Calif.). Sept. 1960. Contract AF33(616)-6791. 283p. (EOS-390-Final(Vol.VII); AD-256881)

Empirical and analytical equations describing the performance of several types of heat exchangers useful in space power systems are given, including nonphase-change heat exchangers, condensers, boilers, sub-cooling mechanisms, and others. The present state-of-the-art concerning materials compatibility, fabrication techniques, knowledge of environmental deterioration, and other factors is presented. Anticipated weights and practical difficulties encountered in systems operation are discussed. (auth)

30798 (NP-tr-751) ELECTRON-BEAM GUNS FOR WELDING OF METALS IN VACUUM. Yu. M. Kozlov. Translated from Svarochnoe Proizvodstvo, No. 1, 38-40 (1961). 14p.

A report of investigations on focusing systems for electron beams used in metal welding is presented. Characteristics of electron guns are discussed and the development of guns which provide 0.8 to 1.5 mm diameter beams with accelerating voltage of 22 to 25 kv is reported. (J.R.D.)

30799 MEASUREMENT OF METAL TRANSFER IN ELECTRICAL CONTACTS BY THE RADIOACTIVE ISOTOPE METHOD. F. Llewellyn Jones, M. R. Hopkins, and C. R. Jones (Univ. of Wales, Cardiff). Brit. J. Appl. Phys., 12: 485-9(Sept. 1961).

The use of radioactive isotopes in the measurement of metal transfer from one electrode of an electrical contact to the other is described, and details of the experimental procedure are given. The relation between matter transfer and circuit inductance at very low values of the inductance was determined for platinum and palladium contacts operating at potential differences of the order of one volt. It is shown that for these metals there is no range of inductance down to 10^{-8} H over which the transfer is independent of inductance. The amount of transfer in relation to the volume of the molten metal bridge between the electrodes is considered, and the significance of the results in the light of theories of the phenomenon of transfer is discussed. (auth)

30800 PREPARATION OF SEALED Sr^{90} AND Fe^{55} SOURCES. Tibor Bálint and Sándor Orsós (Hungarian Petroleum and Natural Gas Research Inst., Veszprém, Hungary and Research Inst. for Heavy Chemical Industry, Veszprém, Hungary). Energia és Atomtech., 14: 237-40 (1961). (In Hungarian)

For the non-destructive determination of the H concentration of organic materials by measuring the absorption of β-radiation by the material, there is a great need for a Sr^{90} source which would allow passage of most of the radiation of the daughter Y^{90}. For this purpose a closed source was prepared using two 4 to 5 μ thick mica sheets to contain the radioactive material sealed with a suitable plastic. The design made it possible to use simultaneously 2 beams for the tests, passing one through the unknown material, the other through a reference specimen. The 21-millicurie source contained 1.6 ml $Sr(NO_3)_2$ evaporated to dryness. A special capsule protected the source against mechanical damage. For similar non-destructive determination of the S concentration of organic compounds a Fe^{55} sealed source was prepared, using 1g of the isotope in the form of Fe_2O_3 with a specific activity of 50.8 millicurie/g. The powder was fixed in the source by shellac. (TTT)

30801 LEAKS IN STANDARD SEALED TELETHERAPY SOURCES. R. J. Cloutier and Marshall Brucer (Oak Ridge Inst. of Nuclear Studies, Tenn.). Health Phys., 6: 32-5 (Aug. 1961).

Teletherapy sources encapsulated in the United States and Canada from 1954 to 1959 were generally of the standard, single capsule, sealed type. One feature of the standard capsule was believed to be its tight seal and its ability to maintain this integrity. Late in 1958, a standard capsule source at the Oak Ridge Institute of Nuclear Studies (encapsulated 1.5 years earlier with Co^{60} metal pellets) developed a leak. This leak resulted in from 30 to 100 mc of activity being released before it was detected. Subsequent investigation of other sealed sources in the United States revealed that thirteen of 200 standard teletherapy capsules had developed leaks. A review of the possible causes of leakage, and of the standard capsule design, fabrication, sealing and initial and subsequent leak testing, has resulted in recommended changes to reduce the probability of future capsule failures. The incidence of failures already encountered, however, has made apparent the importance of routine leak testing of encapsulated sources. (auth)

30802 HYDROGEN LIQUEFIER WITH 50 l/h LIQUID HYDROGEN CAPACITY. A. G. Zel'dovich and Yu. K. Pilipenko (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekh. Eksptl., 6: No. 2, 185-7(Mar.-Apr. 1961). (In Russian)

The construction and performance of a hydrogen liquefier are described. The operational data and losses are tabulated. (tr-auth)

30803 LIQUEFIER FOR VAPOR–HYDROGEN PRODUCTION AND CATALYST FOR HYDROGEN ORTHO-VAPOR CONVERSION. R. A. Buyanov, A. G. Zel'dovich, and Yu. K. Pilipenko (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekh. Ekspt., 6: No. 2, 188-90 (Mar.-Apr. 1961). (In Russian)

A hydrogen liquefier with 22 l/h capacity for liquid and 14 l/h for vapor is described. Catalyst characteristics and specifications are given for the ortho-vacuum conversion of hydrogen, and a method is suggested for calculating the necessary amount of catalyst. (tr-auth)

30804 IMPROVEMENTS IN OR RELATING TO SEALING DEVICES FOR TUBULAR MEMBERS. Herbert Chilvers Knights (to United Kingdom Atomic Energy Authority). British Patent 877,006. Sept. 13, 1961.

A sealing device is designed for effecting an endwise seal between two tubular members of different diameters. The sealing is effected by an annular sealing ring which engages an annular seat on the end of the smaller tubular member. In this way, a seal can be obtained while permitting slight misalignment between the two tubular members. (D.L.C.)

30805 IMPROVEMENTS IN OR RELATING TO APPARATUS FOR REMOTE WEIGHING OF RADIOACTIVE MATERIALS. William Rowell Guest (to United Kingdom Atomic Energy Authority). British Patent 877,064. Sept. 13, 1961.

A balance is designed for weighing, igniting, and reweighing radioactive samples. The balance is mounted above a shielded cubicle and has a rod suspended from its beam and extending into the cubicle with a balance pan

at its lower end. A vertical tube furnace in the cubicle is adapted to be raised to surround the balance pan, and means is provided for withdrawing air from the furnace. (D.L.C.)

30806 IMPROVEMENTS IN ION SOURCES. Guy Nief (to Commissariat a l'Energie Atomique). British Patent 877,112. Sept. 13, 1961.

An ion source for mass spectrometers is designed for ion outputs which are more abundant and more representative of the true isotopic composition of the sample ionized. The ion source, operated without a magnetic field, comprises a filament for emitting electrons, an accelerating grid, a plate at a potential negative to that of the filament, and a fourth electrode at a potential highly negative to that of the plate and having a slit for extraction of the ions. The potential of the filament is negative to that of the grid. (D.L.C.)

30807 IMPROVEMENTS IN OR RELATING TO LIFTING MECHANISMS. Charles John MacFarlane (to United Kingdom Atomic Energy Authority). British Patent 877,620. Sept. 20, 1961.

A grab is designed for removing extraneous objects from fuel element or control rod channels in heterogeneous reactor cores. The grab comprises an outer tube, an inner tube rotatably mounted within the outer tube, and chains connecting the ends of the tubes. In the open position, the chains hang in loops near the sides of the channel; by rotation of the inner tube, the chains are drawn to a taut position, thereby trapping any object situated within the grab. (D.L.C.)

30808 IMPROVEMENTS IN OR RELATING TO COUPLING DEVICES. John Oliver Cowburn and James Leslie Kearney (to United Kingdom Atomic Energy Authority). British Patent 877, 676. Sept. 20, 1961.

A coupling device is designed for the releasable connection of a reactor control rod to a winding cable. The device comprises a tubular part, a sleeve part, and a cylindrical part, and coupling is effected by balls engaged in recesses in the sleeve and cylindrical parts. (D.L.C.)

Heat Transfer and Fluid Flow

30809 (AEEW-R-87) KINETICS OF BOILING HYDRAULIC LOOPS. J. Randles (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Establishment, Winfrith, Dorset, England). Aug. 1961. 68p.

A theory is presented in which the one dimensional equations of motion of a homogenized two-phase fluid are solved in their complete non-linear form. The treatment is appropriate for the study of large flow disturbances in a boiling channel when there is negligible lateral flow. The boiling-channel equations are coupled with the equations of motion of the fluid in the external flow circuit so as to obtain the behavior of the whole system. A MERCURY autocode program is given which carries out all the necessary arithmetic and derives the above behavior numerically. This program is used to explain some hydraulic unstabilities recently observed. (auth)

30810 (TID-13711) BASIC EXPERIMENTAL STUDIES ON BOILING FLUID FLOW AND HEAT TRANSFER AT ELEVATED PRESSURES FOR MONTH OF JULY 1961. Bruce Matzner (Columbia Univ., New York. Engineering Research Labs.). July 31, 1961. 17p. (MPR-X-7-61)

Final tests including one physical burnout made with the spirally wrapped 7-rod test section are described. Calculations, based on experimental data, to compare the validity of the homogeneous model vs. an improved Martinelli model for calculating two-phase frictional pressure drop in spirally wrapped and unwrapped 7-rod bundles are given. (auth)

30811 (TID-13781) BASIC EXPERIMENTAL STUDIES ON BOILING FLUID FLOW AND HEAT TRANSFER AT ELEVATED PRESSURES. Monthly Progress Report for August 1961. Donald Blackford and Bruce Matzner (Columbia Univ., New York. Engineering Research Labs.). Aug. 31, 1961. Contract AT(30-3)-187. 5p. (MPR-X-8-61).

An unsuccessful attempt was made to run the NDA 19-rod test section. The test section failure was caused by a breakdown of the spiral wrapping material. Final assembly on the CU 19-rod test section is nearing completion. The second single-rod test section was run successfully. Thirty-three heat-flux limit points were recorded including one actual physical burnout. (auth)

30812 (UTIA-70) ANALYSIS OF BOILER ROOM PRESSURES FOLLOWING A POTENTIAL RUPTURE OF THE MAIN COOLANT LINE IN A NUCLEAR POWER PLANT. I. J. Billington and I. I. Glass (Toronto. Univ. Inst. of Aerophysics). Aug. 1960. 69p.

An analysis was made of the maximum pressure rise and relevant pressure history that might occur in the boiler room of a nuclear reactor from the complete failure of a main, sixteen-inch, heavy-water, coolant pipe. The boiler room and the 9 ft × 12 ft × 50 ft pressure relief duct were represented by a simplified mathematical model based on one-dimensional, inviscid flow in order to study the transient pressure rise following the failure, and a step-by-step numerical calculation provided the solution. The analysis included the effect of a sealing diaphragm at the upstream end of the pressure relief duct which was assumed to disintegrate within 10 msec after the boiler room pressure reached 1.5 psig. The pressure-time history determined from this analysis shows a rapid rate of pressure rise from the instant of failure levelling off to a peak of 4.4 psig after approximately 0.3 seconds. (auth)

30813 (AEC-tr-4476) FLOW LOSSES IN BENT PIPES. H. Nippert. Translated from Forschungsarb. Gebiete Ingenieurw., No. 320, 1-67(1929). 132p.

The flow and constitution of losses in bent pipes were studied. Directions for tests with 90 and 180° bends of mostly rectangular cross section and constant heights are described. The design of a testing device which would permit the determination of losses with the possibility of varying to the utmost the bend radii, the side ratios, and the cross sectional ratio of the inlet and outlet, and further the velocity distribution in the outlet cross section and the pressures in the bend is suggested. The test bends, the way in which the tests were performed, and their evaluation are described. (M.C.G.)

30814 (AEC-tr-4812) THE EFFECT OF THROTTLING THE FLOW AND OF THE HEATED LENGTH OF PIPE ON CRITICAL HEAT LOADS. V. E. Doroshchuk and F. P. Frid. Translated for Westinghouse Electric Corp., Bettis Atomic Power Lab., Pittsburgh from Teploenergetika, 6: No. 9, 74-9(1959). 9p.

Studies were made of critical heat loads with the flow of water and a steam-water mixture in pipes. The effects of pulsations in the liquid flow and of the heated pipe length were determined. Under conditions of pulsations of the liquid stream, sharp reddening of the pipe set in at comparatively low heat loads. It was found that the length of pipe had no effect on critical heat loads within the limits of the investigated l/d ratios. (M.C.G.)

30815 (AEC-tr-4832) SWIRLING FLOW OF AN INCOMPRESSIBLE FLUID IN A CIRCULAR TUBE. M. A. Goldshtik. Translated for Oak Ridge National Lab., Tenn. from Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, No. 12, 24-31(1958). 13p.

An approximate method for analyzing axially symmetrical swirl flow in a semi-infinite tube is presented based on a linearization of flow equations of an ideal liquid. Solutions are given for loose and tight swirl flows. (D.L.C.)

30816 (UCRL-Trans-694) STUDY OF HEAT EXCHANGE DURING BOILING OF WATER AND ETHYL ALCOHOL IN PIPES. L. S. Sterman, V. G. Morozov, and S. A. Kovalev. Translated by Sergey Shewchuck for Univ. of California Lawrence Radiation Lab., Berkeley from Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R., 2: 40-5 (Oct. 1959). 11p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 6415.

30817 EXPERIMENTAL STUDY OF FLOW AND SEPARATION IN VORTEX TUBES WITH APPLICATION TO GASEOUS FISSION HEATING. J. J. Keyes, Jr. (Oak Ridge National Lab., Tenn.). ARS (Am. Rocket Soc.) J., 31: 1204-10(Sept. 1961).

An experimental investigation of the flow in simple jet driven vortex tubes under conditions dynamically similar to those estimated to be necessary for operation of a vortex cavity reactor indicated that viscous retardation of the vortex motion near the periphery is severe. Estimates of virtual viscosities and skin friction coefficients based on an assumed two dimensional flow field were correlated in terms of the peripheral tangential Reynolds number based on the tube diameter. Friction coefficients so defined for vortex flow appear to be high by a factor of about two compared with those for turbulent flow along a flat plate with zero pressure gradient. Observed tangential velocities are compared with theoretical calculations for viscous vortex flow in terms of the turbulent radial Reynolds number. This comparison suggests that virtual viscosity probably decreases with decreasing radius. Extrapolation of the experimental results to typical reactor operating conditions indicated the need for small diameter tubes and recirculation of a large fraction of the inlet gas in order to achieve adequate vortex strength without exceeding an allowable exit mass flow rate. Quantitative measurements of concentration profiles for separation of helium and a heavy fluorocarbon vapor were made using a radial gas sampling probe and thermal conductivity analysis. The data are compared with laminar flow separation theory. (auth)

30818 THE EFFECT OF MAGNETIC FIELDS ON THE FLOW OF A CONDUCTING FLUID THROUGH A DUCT. Jacqueline Naze (Centre National de la Recherche Scientifique, Marseille). Astronautica Acta, 7: 261-75(1961). (In French)

The effect of magnetic and electric fields on quasiunidimensional flow of a perfectly conducting fluid through a duct does not modify it. This effect is important for imperfectly conducting fluids, and allows: non uniform, stationary flows in a duct with constant cross-section; transonic flows with sonic point at non extremum cross-section, in ducts with slowly varying cross-section; and increased acceleration by means of an appropriate magnetic field. The stability of these flows is also studied for second order perturbations which do not modify the quasiunidimensional character of the flow. It is seen that, whatever the electric conductivity be, choking appears in decelerated transonic flows. (auth)

30819 AN EXACT SOLUTION TO A PROBLEM IN HEAT TRANSFER. C. H. J. Johnson (Commonwealth Scientific and Industrial Research Organization, Melbourne). Australian J. Phys., 14: 317-20(June 1961).

A problem concerning the parallel flow of fluid over a heat-conducting half space, the motion being started impulsively, is solved. An exact unsteady-state solution is given. A symmetry such that the convection terms in the equation for the fluid vanish identically is involved. These equations are thus uncoupled in the sense that the flow velocity is independent of the temperature distribution and the temperature depends on the flow only through the viscous dissipation function. Thus the problem reduces to solving the heat conduction problem for a composite body with heat generation in one body, the fluid. (L.N.N.)

30820 THE EFFECT OF NON-UNIFORM HEATING ALONG A PIPE ON THE BURN-OUT VALUE OF THE HEAT FLUX. M. A. Styrikovich, Z. L. Miropol'skii, and Chao-yuan Shen (Krzhizhanovskii Inst. of Energetics, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 139: 859-62(Aug. 1, 1961). (In Russian)

Experiments were performed with ascending movement of a vapor–water mixture in the tube, and of water subcooled below the saturation temperature at pressures of 100 and 180 atm, and at weight flow rates of 400, 850 and 2000 kg/m^2-sec. Non-uniform heating of the tube 160 mm long by 6 mm in diameter was effected by electrically heating a tube whose thickness varied linearly along the length of the tube. The ratio of the maximum heat flux to the average heat flux was 2.3, and the ratio of the maximum heat flux to the minimum heat flux was 4.9. The occurrence of the critical heat flux was observed visually. The critical heat flux was determined from the measured electrical current, the electrical resistance of the pipe at the average wall temperature, and the tube geometry. The critical heat flux for non-uniform heating of the tube was about twice as great as the critical heat flux for uniform heating of the tube, when the heat flux was rising along the tube length. The critical heat flux was smaller by a factor of two with decreasing heat flux along the tube length. (TTT)

30821 MIXING OF COMPRESSIBLE FLUIDS. E. D. Kennedy (General Applied Sciences Labs., Inc., Westbury, L. I., N. Y.). J. Appl. Mechanics, 28: 335-8(Sept. 1961).

The problem of the mixing of two streams of the same compressible fluid in a constant-area duct is solved by applying certain dimensionless parameters first used by Kiselev. The extension to dissimilar fluids or to more than two streams is straightforward. Although the analysis is unrestricted, detailed results are given only for the case where one stream is sonic or supersonic and the other sonic or subsonic at the origin of mixing. For this case, the second law of thermodynamics indicates that, of the two solutions of the conservation equations, the subsonic one is always permitted while some of the supersonic solutions are thermodynamically impossible. Upon examination of experimental data, it is concluded that of the admissible supersonic solutions, only one may be expected to occur. The establishment of this supersonic solution with its relatively high stagnation pressure leads to the conclusion that when the initial temperatures are sufficiently different there exist thermodynamically possible solutions with a stagnation pressure higher than that of either of the two initial streams. (auth)

30822 THE LAMINAR BOUNDARY LAYER ON A HOT CYLINDER FIXED IN A FLUCTUATING STREAM.

R. J. Gribben (Massachusetts Inst. of Tech., Cambridge). J. Appl. Mechanics, 28: 339-46(Sept. 1961).

The equations for nonsteady, two-dimensional low-speed compressible flow in the laminar boundary layer are solved approximately by use of the Pohlhausen technique with the assumption of quartic profiles for the velocity and temperature. The external flow considered is of the form of a steady basic velocity with a superimposed small amplitude oscillation such as may arise, for example, when a sound wave is present in a uniform incident stream. The analysis is then applicable to the case of a hot cylinder fixed in such a stream. Terms of the order of the incident stream Mach number are neglected in the expressions for external flow quantities (whereas the low-speed boundary-layer equations involve errors of the order of only the square of this Mach number). Two special cases are worked out—the flow over a flat plate for which there is fair agreement with available exact calculations, and the flow over a circular cylinder. (auth)

30823 UNSYMMETRICAL FLOW PATTERNS PAST A FINITE WEDGE PROFILE IN A HIGH SUBSONIC STREAM. J. B. Helliwell (Royal Coll. of Science and Tech., Glasgow). Proc. Cambridge Phil. Soc., 57: 401-14(1961). (AFOSR-916)

The flow pattern past a thin wedge-like profile set at a small angle of attack in a gas flowing with high subsonic or sonic velocity is discussed within the order of the transonic approximation. In the model considered the flow has a stagnation point at the nose of the wedge and breaks away, with velocity equal to that of sound, from the shoulders. The velocity is subsonic throughout the whole field of flow. The solution of the boundary-value problem for the wedge in a channel is formulated as a pair of dual integral equations. The complete solution is given for the wedge in a free stream and the dimensions of the profile, together with the lift coefficient, are computed as functions of the transonic similarity parameter. (auth)

30824 PERMEABILITY MINIMUM OF GASES FLOWING THROUGH POROUS FILMS. V. M. Amonenko and B. M. Vasyutinskii (Khar'kov Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Ukrain. Fiz. Zhur., 6: 263-6(Mar.-Apr. 1961). (In Ukrainian)

The nature of gas flow through porous films precipitated in vacuum was studied. A minimum is found on the gas permeability—pressure curve, which indicates the presence of pores with direct channels. Films precipitated on a polished molybdenum surface at 400 to 750°C have a great number of micropores, which are closed in the layers near the molybdenum surface. The number of through pores increases with the roughness of the condensation surface. (auth)

30825 SOME TYPES OF DIFFICULTIES ENCOUNTERED IN THE SIMULATION OF EXCHANGERS. Denise Bettembourg (Commissariat à l'Énergie Atomique, Saclay, France). p.103-8 of "Seminar on Analogue Methods in Nuclear Energy Problems, Actes—Proceedings, Brussels, April 21-23, 1960." Brussels, Presses Academiques Europeennes, 1961. (In French)

The simulation of exchangers poses often difficult problems. The difficulties appear first in the equations for physical phenomena; they appear later at the moment of resolution since more and more complex formulations can take place from the unstable electronic structures. These difficulties are worked out by making analyses of several types of exchangers. The results in each case are given. (tr-auth)

30826 COMPARATIVE STUDIES OF COOLING OF TUBES BY RHEOELECTRIC ANALOGY. G. Burnay (Université, Liege). p.124-7 of "Seminar on Analogue Methods in Nuclear Energy Problems, Actes—Proceedings, Brussels, April 21-23, 1960." Brussels, Presses Academiques Europeennes, 1961. (In French)

A study is reported in which rheoelectric analogy was used to study cooling of tubes for the simple case of longitudinal fins. Transposing to a rheoelectric analogy, the coefficient h (local average distribution at the outside contour of the tube) corresponds to a distributed resistance supplying the contour of the model. In practice, one arranges the local resistances related to small elements of the edge of the paper model conductor. The results are compared with experimental results. (T.R.H.)

30827 HEAT TRANSFER SYSTEMS. (to Sulzer Freres, Societe Anonyme). British Patent 877,748. Sept. 20, 1961.

A heat transfer system using a heat-releasing medium to vaporize and superheat a working medium is designed for use in nuclear power plants. The system is divided into sections corresponding to heating, vaporization, and superheating of the working medium, and a liquid separator is interposed between the vaporization and superheating sections. (D.L.C.)

30828 IMPROVEMENTS IN OR RELATING TO TUBULOUS VAPOUR GENERATORS AND TO STEAM GENERATING SYSTEMS INCORPORATING WATER COOLED NUCLEAR REACTORS. Anthony James Taylor (to Babcock & Wilcox Ltd.). British Patent 878,232. Sept. 27, 1961.

A tubulous vapor generator suitable for use in the generation of steam in power plants incorporating water cooled reactors is described. The steam generator has a pressure vessel containing a bank of upright, spaced tubes the ends of which are shaped to extend laterally to tube plate means disposed at the inner ends of inlet and outlet chambers. The chambers project laterally from the pressure vessel wall into the pressure vessel and a jacket surrounding the tube bank. The chambers form, between the tubes, an internal riser space open at the bottom to a liquid space of the vessel and in communication at the top with a vapor space of the vessel. The chambers form, between the jacket and the wall of the vessel, an external downcomer space. The tubes and interior of chambers are usually made of austenitic stainless steel. (N.W.R.)

Instrumentation

Refer also to abstracts 31269 and 31663

30829 (AD-259721) A FAST NEUTRON COUNTER USING SEMICONDUCTOR DIODES AND COINCIDENCE CIRCUITRY (thesis). Carl Lawrence Rucker (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio). Mar. 1961. 39p. (GNE/Phys/61-16)

Silicon solid-state detectors were used in conjunction with coincidence circuitry to detect and measure the energies of charged particles resulting from a $Li^6(n,\alpha)H^3$ reaction. Neutrons at 5.24 Mev were obtained by bombarding deuterium gas with 2 Mev deuterons from a 2 Mev Van De Graaff. A chamber was designed and constructed permitting the preparation, measurement, and the positioning of a Li^6 foil between the two silicon detectors without breaking the vacuum. A resolution of 578 Kev and a counting efficiency of 4×10^{-8} were obtained where efficiency equals counting rate/neutron flux. (auth)

30830 (AFOSR-1014) PHASE STABILITY IN FREQUENCY MULTIPLIERS. Ralph R. Dimmick (California.

Univ., Berkeley. Electronics Research Lab.). June 2, 1961. Contract AF49(638)-1043. 51p.

A description is given of work pertaining to phase stability of frequency multipliers with emphasis on Class C vacuum-tube frequency multiplier chains. Various sources of phase perturbations were considered and experimental work performed to establish the magnitude of their effects on a practical device. Temperature variation was found to be the most serious source of phase instability. A general discussion of frequency standards is included and the need for frequency multipliers in the translation of a standard frequency is pointed out. Frequency multiplier chains are discussed and the Class C multiplier selected for the major portion of the work because of the simplicity of its design and general use. Sources of phase perturbation considered include tube noise, temperature variation, and supply-voltage variation. The effects of such sources were determined on an experimental multiplier chain and recommendations were made regarding multiplier chain design. Indications were that frequency errors caused by phase perturbations could be held to less than $1:10^{11}$ with suitable precautions. (auth)

30831 (ARL-146) DEVELOPMENT OF METHODS FOR THE MEASUREMENT OF TEMPERATURES UP TO 10^5 °K. Technical (Final) Report. Woldemar Bötticher, Hermann Christmann, Siegfried Fahrentholz, and Hans Jürgen Kusch (Kiel. Universität. Institut für Experimentelle Physik). June 30, 1961. Contract AF61(052)-368. 50p.

Three different ways were followed to obtain plasmas having temperatures of about 10^5 °K. The first experiment aimed to pulse a confined electric arc with high current. This did not lead to the desired high temperatures because the confinement broke down. The second experiment tried to use the magnetic compression by an outer magnetic field (θ-pinch) to compress and to heat the plasma simultaneously. Compression of the plasma of an arc burning at atmospheric pressure was not possible. A low pressure discharge was not sufficiently preionized. The use of a second condensor bank for pre-ionization resulted into contraction and heating. The obtained temperatures were about 40000°K. These temperatures may be further increased with more stored energy and a faster energy release of the capacitor bank feeding the magnetic field. The third experiment was the linear pinch. Discharge in helium proved the existence of two outer zones of different temperatures. In the center of the discharge tube temperatures higher than 80000°K were obtained. The pressure was about 15 atm and the radiation corresponds to thermal excitation. In the last experiments the production of plasmas of about 10^5 °K was achieved. The methods developed to measure temperatures, proved to be exact for temperatures up to 50000°K, could be used in the present research. (auth)

30832 (AWRE-NR/P-3/61) A TUNED AUDIO AMPLIFIER AND PHASE-SENSITIVE DETECTOR SYSTEM. R. J. Lamden (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). Sept. 1961. 35p.

A description is given of an apparatus designed to measure the alternating component of an ion current modulated approximately sinusoidally at 800 cps by an interacting cross beam passed through a chopping wheel. (auth)

30833 (HW-69203) AN ADIABATIC CALORIMETER FOR STOPPING POWER MEASUREMENTS IN THIN FOILS. H. V. Larson, I. T. Myers, R. I. Elder, and W. J. Dittrich (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 1961. Contract AT(45-1)-1350. 16p.

An adiabatic calorimeter for measuring directly the energy absorbed in a thin foil is described. The calorimeter was used to measure the stopping power of 2-Mev electrons in 0.0009- and 0.004-in. thick aluminum foils. The measured stopping power agreed closely with theoretical values. (auth)

30834 (IFA/M-21) MAGNETIC FIELD SHAPE FOR NUCLEAR INSTRUMENTS WITH RADIALLY CONSTANT FIELD INDEX IN THE MEDIAN PLANE. C. C. Iliescu (Academia R. P. R. Institutul de Fizica Atomica, Bucharest). 1961. 6p.

Equations are derived for the scalar potential, induction field components, and vector potential of a magnetic field as a function of the field index value in the median plane, which is assumed to be radially constant. The magnetic material is assumed to have an infinite permeability, and the finite extension of the pole pieces is neglected. The equations are useful for studying particle motion and calculating the pole face shape. (D.L.C.)

30835 (JINR-P-385) SISTEMA UPRAVLENIYA, FORMIRUYUSHCHAYA IMPUL'S S MALOI ZADERZHKOI DLYA RABOTY S GODOSKOPOM V REZHIME IMPUL'SNOGO PITANIYA. (Control System Forming Slow Delay Pulse Operating with Hodoscope with Pulse Feeding). E. Iliesku (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1959. 11p.

A control system was designed for a hodoscope operating with a system of pulse-fed gas discharge counters. The hodoscope is used for spin correlation measurements in elastic p-p scattering at large energies. The installation has a high resolving power and fast pulse control. Four scintillation counters operate in coincidence and two in anticoincidence in order to produce a minimum retention pulse of several hundred volts with a short front. (R.V.J.)

30836 (KAPL-M-JAM-4) DEFLECTION MEASUREMENTS BY MAGNETIC MEANS. SYSTEM DESCRIPTION. J. A. McCann and H. G. Garab (Knolls Atomic Power Lab., Schenectady, N. Y.). May 31, 1961. Contract W-31-109-Eng-52. 35p.

A measurement system designed to precisely determine motion of test assemblies by magnetic means in high pressure coolant systems and to the magnet material transition temperatures, approximately 650°F, is described. The measurement plan uses calibrated magnets embedded in a test structure. The proposed low temperature testing of plexiglas mockup of fuel assembly designs is discussed. The magnetic circuitry, electronic circuitry, and mechanical design of the measuring system are described. Test procedures are outlined. (M.C.G.)

30837 (KAPL-M-SLJ-4) DELIVERY ACCURACY OF THE METROHM POTENTIOGRAPH. S. L. Jones (Knolls Atomic Power Lab., Schenectady, N. Y.). May 15, 1961. Contract W-31-109-Eng-52. 7p.

The ability of the Metrohm Potentiograph to accurately deliver liquid from its automatic buret was determined by comparing the weight of water at various intervals in its range with the reading of the recorder chart. Accuracy of delivery was generally better than 0.1% relative, and appeared to be limited chiefly by the ability of the operator to read the graph paper used with the instrument. (auth)

30838 (NDA-2131-34) CONCEPTUAL DESIGN OF A VAPOR VOLUME FRACTION INSTRUMENT. M. H. Kalos, S. A. Davis, P. S. Mittelman, and P. Mastras (Nuclear Development Associates, Inc., White Plains, N. Y.). Apr. 15, 1961. Contract AT(30-1)-2303(IX). 29p.

The preliminary design is described of equipment to carry out experiments on boiling burnout in which the

average coolant density as a function of coolant channel length as well as local coolant densities may be measured. It appears that by use of the equipment, average densities can be accomplished in a few seconds, while determination of a complete density map (with 5% error) across a plane of the assembly requires approximately one hour. (J.R.D.)

30839 (NP-10233(p.98-117)) HUMAN BODY RADIATION MONITORS. D. H. Pringle.

The use of human body radiation monitors for body potassium determination, medical tracer studies, reactor personnel monitoring, and fall-out detection is discussed. The shielding and calibration problems are discussed in some detail. Several apparatus of the multi-crystal array type are described. (D.L.C.)

30840 (NP-10233(p.118-34)) THE DEVELOPMENT OF IMPROVED NUCLEAR MEASURING INSTRUMENTS. Denis Taylor (Plessey Nucleonics Ltd., Northampton, England).

New techniques and trends being developed in nuclear measuring instruments are reviewed for neutron-sensitive detectors, scintillation counters, and solid state detectors. Methods are described for decreasing the time of routine sample monitoring by selective counting. (D.L.C.)

30841 (NP-10742) DEVELOPMENT AND CALIBRATION OF A COLD WIRE PROBE FOR USE IN SHOCK TUBES. Hypersonic Research Project Memorandum No. 62. Walter H. Christiansen (California Inst. of Tech., Pasadena. Guggenheim Aeronautical Lab.). July 1, 1961. Contracts DA-04-495-Ord-1960 and 3231. 134p.

The use of a fine unheated (cold) wire for making shock-tube flow measurements is investigated. The operation of the instrument depends on the transient nature of the shock-tube flow. A description is given of the construction and calibration of the cold wire. The experimental law for the rate of gain of heat to the wire in air is determined for Mach numbers from 0.4 to 1.9 and Reynolds numbers from 0.035 to 3,500 based on the wire diameter and the conditions in the hot flow following the initial shock wave. Similar measurements are reported for argon. The heat transfer measurements cover the continuum region, the slip and transitional regions, and extend into the free-molecule flow region. The dimensionless results are compared with hot wire measurements obtained in wind tunnels and are found to differ slightly. A difference exists because the cold wire gains heat from the fluid while the hot wire loses heat to the fluid. The measurements are very repeatable and self-consistent and indicate that the wire can be used to give an accurate flow measurement in the shock tube. Some potential applications of the wire for the study of shock-tube flows are presented. (auth)

30842 (NP-10796) A HIGH-TEMPERATURE LINEAR RISE CALORIMETER FOR MEASURING STORED ENERGY IN IRRADIATED GRAPHITE. D. F. Davidson, E. Harrison, W. Jaques (United Kingdom Atomic Energy Authority. Reactor Group, Capenhurst, Ches., England), and J. A. Mounsey (United Kingdom Atomic Energy Authority. Reactor Group, Windscale, Cumb., England). June 1, 1961. 28p. (TRG Report 53)

A calorimeter was developed which extends the upper temperature limit for measurement of stored energy in irradiated graphite to 800°C. The method is similar to that of previous calorimeters, which were limited to 500°C, and uses temperature control loops and a reference specimen. Details of design are given, including that of the electronic equipment, and the results of preliminary tests are described; these led to some modifications to obtain a closer approximation to adiabatic conditions. A significant improvement in the accuracy of measurement at the higher temperatures was obtained by enclosing the specimens in thin copper sheaths to reduce their emissivity. Final test results showed an over-all error in the measurement of dS/dT of about ±0.01 cal/g degC. (auth)

30843 (SCTM-91-61(72)) A METHOD OF CALIBRATING BENIOFF SEISMOMETERS. H. J. Plagge, H. G. Laursen, and C. J. Northrup, Jr. (Sandia Corp., Albuquerque, N. Mex.). Aug. 1961. 16p.

A series of tests to determine calibration methods suitable for use with Benioff-type seismometers manufactured by the Geotechnical Corporation was run. Three methods of determining the magnification of the systems were used and generally good agreement between the several methods was reached. It is believed that the accuracy of any magnification measurement may be quoted as within 2% under most circumstances. (auth)

30844 (SCTM-136-61(14)) ULTRASONIC CLEANING OF TRANSISTORS. J. A. Hood (Sandia Corp., Albuquerque, N. Mex.). June 1961. Reprinted Aug. 1961. 19p. Contract [AT(29-1)-789].

The resonant frequencies generally associated with transistor construction are analyzed, and a high failure of transistors when they are cleaned ultrasonically is predicted. (P.C.H.)

30845 (SCTM-209A-53(52)) CALIBRATION OF A PEAK CURRENT GAGE DEVELOPED AT SANDIA CORPORATION. G. E. Baker, T. C. Looney, W. B. Pafford, and G. E. Reis (Sandia Corp., Albuquerque, N. Mex.). Dec. 28, 1953. Revised Aug. 21, 1961. Contract [AT(29-1)-789]. 36p.

Methods are presented for calibrating a peak current gage. A statistical treatment of a large number of calibration points for a single gage leads to an estimate of the accuracy of the gage. Comparisons are made between the calibration curve developed for a single gage and the response of several similar gages. The results indicate the reliability of the use of one calibration curve for all gages of a particular type. (auth)

30846 (SCTM-268-60(13)) BELLOWS TEMPERATURE RECORDER. James T. Boag (Sandia Corp., Albuquerque, N. Mex.). Sept. 21, 1960. Contract [AT(29-1)-789]. 12p.

The Bellows Temperature Recorder records the maximum and minimum temperatures experienced over a possible range of –100 to ±350°F with an accuracy of ±2% of the full range. The design, assembly, and testing of feasibility models of the recorder are described. The recorder consists of a bellows $\frac{5}{32}$ inch in diameter by 2 inches long attached to a reservoir filled with silicone fluid. Changes in liquid volume with temperature deflect the bellows which positions two riders at the extremes of its travel. (auth)

30847 (TID-3566) MASERS. A Literature Search. Henry D. Raleigh, comp. (Division of Technical Information Extension, AEC). Aug. 1961.

Included are 493 references on gas and solid state maser and laser theory, design, and operation. The references are given to reports and U.S. and foreign journals published from 1949 to 1961. (P.C.H.)

30848 (UCRL-6425) A SIMPLE, HIGH-LEVEL ALPHA AIR MONITOR. C. L. Lindeken, E. L. Beard, and O. M. Barlow (California. Univ., Livermore. Lawrence Radiation Lab.). June 16, 1961. Contract W-7405-eng-48. 16p.

Design features are described for a continuously-indicating α air monitor with an audio alarm in case of high-level airborne activity. The monitor features are simplicity

and economy of design, small size, light weight, operation at a low noise level, and minimal maintenance. Sampling flow rate is controlled at 2 cfm. (auth)

30849 (UCRL-9476) AUTOMATIC DATA PROCESSING; PARTIAL PROCEEDINGS OF AN INFORMAL MEETING HELD SEPTEMBER 15, 1960 AT LAWRENCE RADIATION LABORATORY. Paul V. C. Hough and John L. Brown, eds. (California. Univ., Berkeley. Lawrence Radiation Lab.). Nov. 21, 1960. Contract W-7405-eng-48. 21p.

Papers presented at an informal meeting of personnel especially interested in automatic processing of bubble chamber data are reported. Included are papers on computer programs and uses, mathematical representation of slow particle orbits, spatial reconstruction of particle tracks in bubble chambers, direct three-dimensional measurement, low-budget efforts, track filtering and description of programs HECK, GUTS, FOG, CLOUDY, FAIR, and EXAMIN. (J.R.D.)

30850 (UCRL-13009) FAST NEUTRON DETECTION FOR TIME OF FLIGHT SPECTROMETRY. Final Report. (Solid State Radiations, Inc., Los Angeles). May 30, 1961). For Univ. of California Lawrence Radiation Lab., Livermore. Contract W-7405-eng-48. 39p.

The development of a solid state neutron detector system with nanosecond response for use in neutron time-of-flight measurements is described. The neutron energy range of interest is 0.5 to 10 Mev. A study of avalanche transistors was made, and R-C wide band amplifiers were designed and evaluated. (D.L.C.)

30851 (Y-1367) A DUAL PLATING CURRENT REGULATOR. J. J. Henry (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). Sept. 11, 1961. Contract W-7405-eng-26. 12p.

A dual output current regulating system has been designed to operate from a commercial electroplating unit which does not provide adequate regulation to accurately control plating currents in the range from 15 to 110 ma. Dual outputs were provided to make it possible to perform two electroplating operations concurrently in the same or different cells. (auth)

30852 (AEC-tr-4813) PRACTICAL APPLICATION OF THE STANDARDIZED IMAGE QUALITY INDICATOR [PENETROMETER] USED IN RADIOGRAPHY. G. Chanty. Translated for Westinghouse Electric Corp., Bettis Atomic Power Lab., Pittsburgh from Soudure et tech. connexes, 13: Nos. 1-2, 33-42(1959). 13p.

The use of a stepped indicator with drilled holes for determination of image quality in radiographic control is discussed. The design and arrangement of step thicknesses and hole diameters are described. To determine to what angle of inclination the constancy of the visibility index persists in practice, systematic tests were made by radiographing a penetrometer through various thicknesses of steel and varying progressively its orientation with respect to the direction of radiation. It was found that the visibility is not changed when the inclination does not exceed 40°. Economical conditions of manufacture are described. It was found that varnish could be used to protect the holes in the penetrometer. (M.C.G.)

30853 (AWRE/Trans/22) TWO-FILAMENT SURFACE IONIZATION SOURCE FOR A MASS SPECTROMETER. R. N. Ivanov and G. M. Kukavadze. Translated by F. E. Wallwork (United Kingdom Atomic Energy Authority Atomic Weapons Research Establishment, Aldermaston, Berks, England) from Pribory i Tekh. Ekspt., 2: No. 1, 106-10 (1957). 15p.

A description is given of an ion source for a mass spectrometer. The source is intended for the analysis of substances in the solid state and is based on the surface ionization effect. Unlike the widely adopted thermionic source where neutral atoms as well as positive ions caused by surface ionization are evaporated simultaneously from one emitter; in the setup described the atoms of the material are evaporated from one filament and ionization takes place on the other. This separation of the process of evaporation and ionization makes for greater efficiency. (auth)

30854 (NP-tr-769) MEASUREMENTS OF THE ANTHRACENE ABSORPTION AT 3800 A WITH LINEARLY POLARIZED UV LIGHT ON A NAPHTHALENE–ANTHRACENE MIXED CRYSTAL. W. Maier and H. Wimmel. Translated by R. E. Whan and G. A. Crosby (Univ. of New Mexico, Albuquerque) from Z. Elektrochem., 59: 876-80(1955). 9p.

On a naphthalene crystal with 3.6×10^{-4} mole percent anthracene, the absorption produced by the 3800-A band of anthracene was measured with ultraviolet radiation which was polarized parallel to the crystallographic a or b axis respectively. The results showed that it is possible in this way to accurately determine the orientation of the anthracene molecule within narrow limits. (auth)

30855 (SCL-T-380) THE ELECTROSTATIC ELECTRON MICROSCOPE OF HIGH RESOLUTION. H. Mahl. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.) from Z. tech. Physik, 20: 316-17(1939). 7p.

A purely electrostatic ultramicroscope with two electrostatic single lenses, which are used in such a way that a subdivision of the high potential becomes superfluous, is described. The performance efficiency of this microscope was demonstrated and ultramicroscopic photograph samples are included. The resolution limit of the instrument was situated below 15 mμ. (auth)

30856 (UCRL-Trans-709(L)) STUDY OF THE FLUORESCENCE OF RARE GASES EXCITED BY CHARGED NUCLEAR PARTICLES. UTILIZATION FOR THE DETECTION OF NUCLEAR RADIATIONS BY SCINTILLATION. Lydie Koch (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). Translated for Univ. of California Lawrence Radiation Lab., Livermore, from report CEA-1532. 1960. 174p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 11150.

30857 (UCRL-Trans-715(L)) BASIC EQUATIONS FOR DESIGN OF MECHANICAL NEUTRON SELECTORS. Jaromir Juna. Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Livermore) from Czechoslov. J. Phys., 8: 592-9(1958). 12p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 6461.

30858 DIFFERENTIAL MANOMETER FOR MEASURING LIQUID DENSITIES. D. V. Neagu (Joint Inst. for Nuclear Research, Dubna, USSR). Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz. Studii cercetări fiz., 12: No. 1, 55-9(1961). (In Rumanian)

A manometer is suggested for measuring densities of two-component liquids in bubble chambers. The manometer is filled with water and mercury with the free ends touching the water and the liquid to be measured. A formula is developed for determining the density of the liquid in relation to the densities of the water and mercury as well as in relation to the liquid levels in connecting and free tubes. The order of error in measuring the density of $CH_3 + C_3H_8$ solution is about 1%. (tr-auth)

30859 CONTINUOUS MEASUREMENTS OF ATMOSPHERIC β RADIOACTIVITY. R. Literat, St. Meitert, M. Oncescu, and I. Petriu (Inst. of Nuclear Physics, Bucharest). Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz. Studii cercetări fiz., 12: No. 1, 87-101(1961). (In Rumanian)

The design is given of an installation for continuously measuring β activity in the atmosphere. Criteria important to the measurements are discussed. A typical 24-hour diagram is included. (R.V.J.)

30860 A LEAK DETECTOR PTI-4A FOR MASS SPECTROMETRY. M. Pascalau and A. Muller (Inst. of Nuclear Physics, Bucharest). Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz. Studii cercetări fiz., 12: No. 1, 157-64(1961). (In Rumanian)

Descriptions are given of a helium leak detector. Specifications and construction details are included. (R.V.J.)

30861 SPECTROGRAPH FOR THE STUDY OF ELECTRONIC PARAMAGNETIC RESONANCE IN THE DOMAIN OF MICROWAVES. I. Pascaru and A. Valeriu (Inst. of Nuclear Physics, Bucharest). Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz. Studii cercetări fiz., 12: No. 1, 165-9(1961). (In Rumanian)

An electron paramagnetic resonance spectrograph operating at a wavelength of 3 cm is described. The sensitivity of the spectrograph is 5×10^{-9} mole for a resonance width of 2.7 Gauss and a signal-to-noise ratio of 5:1. (tr-auth)

30862 ON THE DESIGN, PHYSICAL PROPERTIES AND PRACTICAL APPLICATION OF SMALL CONDENSER IONIZATION CHAMBERS. Holger Skoldborn. (Univ. of Lund, Sweden). Acta Radiol. Suppl. 187: 1-108(1959). (In English)

A study is made of the Bg-chamber used for radiation dosimetry. Attention is directed to different dielectric effects in the insulator: static and radiation-induced conductivity, residual charge, and apparent leakage. The influence of the dielectric effects on dose measurement is also investigated. A detailed explanation is given for the deviation from linearity between charge loss and dose. The angular dependence of the Bg-chamber under different conditions is given diagrammatically. The energy dependence within the range 0.04 to 12 mm Cu is given in a diagram. The investigation shows that the Bg-chamber is sensitive in either air or a phantom and is suitable for different types of depth dose measurements. Results also show that for 99.8% collection efficiency an electrode voltage of 10 volts at 600 r/min and 3 volts at 6 r/min is necessary. The effects of mechanical shock, humidity, time dependence, and temperature on the Bg-chamber are also studied and recommendations are presented for each effect. Different types of reading instruments, such as electrometers, are also evaluated for the chamber. (N.W.R.)

30863 DETERMINATION OF EXCITATION SPECTRA WITH A RECORDING SPECTROPHOTOMETER. Claude W. Sill (U. S. Atomic Energy Commission, Health and Safety Div., Idaho Falls, Idaho). Anal. Chem., 33: 1579-84(Oct. 1961).

A simple and inexpensive accessory was developed to permit the determination of excitation spectra of fluorescent materials with a recording spectrophotometer. The accessory consists of three front-surfaced mirrors arranged so that the light from the monochromator is redirected to pass through a sample cell at a right angle to the direction taken by the fluorescent light from the cell to the phototube compartment. The signal from the detector reflects the change in intensity of fluorescent light as a function of the wave length of the light incident upon the sample. Resolution and stray light characteristics of the resulting spectra are as good as those of the spectrophotometer used. After correcting for the emission characteristics of the light source, excitation spectra of fluorescent materials parallel closely their absorption spectra and can be used in a similar manner as an analytical tool. However, the excitation spectra may be thousands of times more sensitive and applicable in the presence of other absorbing but nonfluorescent species that would interfere seriously with absorption measurements. Several examples of practical importance are given. (auth)

30864 METHODS AND INSTRUMENTS FOR MEASUREMENTS OF MINIMAL GAS PRESSURES. VII. IONIZATION MANOMETER. Helmut Schwarz RCA, Somerville, N. J.). Arch. tech. Messen, Lfg., 302: 49-52(Mar. 1961). (In German)

The use of an ionization manometer for measurements of low gas pressures is discussed. Topics covered include gas absorption, wall charge and other purely electrical influences, an ionization manometer with glowing cathode, the standard factor C, special tube construction, wiring, an ionization manometer with a cold cathode, and an ionization manometer with a radioactive source. A series of methods were proposed and tested which used the connection between gas pressure in the volume and surface effects. (M.C.G.)

30865 VACUUM MEASUREMENT TECHNIQUES. K. G. Müller (W. C. Heraeus G.m.b.H., Hanau, Ger.). Arch. tech. Messen, Lfg., 302: R51-4(Mar. 1961). (In German)

On the basis of suitable principles for the measurement of vacuums, characteristic properties and ranges of measurement for which the described vacuum measuring instruments are produced are given as well as references to the possibilities of application and suitability of the instruments in the practice of vacuum measuring techniques. Problems of the vacuum measurements, especially in the high vacuum range, are discussed in this connection. Also the important search for leaks in the vacuum techniques and the standing possibilities and instruments for this are treated. Finally the problems resulting from the necessity for control of the operations and the requirements for extensive automation of vacuum processes and units and the possibilities for their solution are presented. (tr-auth)

30866 COUNTING STATISTICS IN X-RAY SPECTROSCOPY. R. C. Stanley (Central Electricity Research Lab., Leatherhead, Surrey, Eng.). Brit. J. Appl. Phys., 12: 503-6(Sept. 1961).

An investigation was made to determine whether the secondary x-ray photons arrive in a random manner in a commercially available x-ray fluorescence spectrometer, and if so, how may the available counting time be best used. A sufficiently large number of observations was taken to allow a full statistical analysis to be made and compared with theoretical predictions. In addition, an experimental investigation was made into the timing accuracy and its effect on the final count rate. It was found that for very high counting rates, above 10,000 counts/sec or long counting times, above about 2 minutes, small instrumental errors tend to occur, but for count rates generally obtained in practice, the x-ray photons are emitted in a random manner and a Poisson distribution is obtained. In practice one could expect a single observation to be within 0.6% of the true value for a 256,000 count or 1.3% for a 64,000 count. The necessary statistics for measurements of a given accuracy are set out in a form readily usable by the x-ray spectroscopist, together with formula, and procedure for obtaining the greatest net accuracy when only a limited time is available. (auth)

30867 ELECTRON-OPTICAL CONDITIONS AT VENETIAN BLIND TYPE DYNODES AND THEIR EFFECTS IN PHOTOMULTIPLIERS. P. Görlich, A. Krohs, and H. J. Pohl (VEB Carl Zeiss Jena, Jena, Ger.). Brit. J. Appl. Phys., 12: 525-6(Sept. 1961).

Venetian blind type dynodes were investigated to determine their suitability for use in electron-optically efficient photomultipliers for photometry. This was accomplished by means of the electrolytic trough. It was concluded that the nuclear-spectrometric resolution could probably be improved from a half-width of 7.5% to one of 6% or less if a secondary emission system were used that was more ideal than the blind-type dynode system; and that Venetian blind type multipliers are of no use when measurements calling for a short time rise are involved. (L.N.N.)

30868 SENSITIVE AMPLITUDE ANALYZER WITH CONSTANT RELATIVE CHANNEL WIDTH. B. Sojka (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Prague). Československ. časopis pro fysiku, A 11: 307-13(1961). (In Czech.)

A survey is given of measurements of the energies of gamma spectra with constant absolute and relative channel width. An apparatus with constant relative channel width is described which does not use a linear amplifier in the measuring chain. (auth)

30869 LONG-DECAYING CALCIUM–STRONTIUM LUMINOPHORS. V. Patrovski (Inst. of Raw Materials, Prague). Collection Czechoslov. Chem. Communs., 26: 1799-1804(July 1961). (In Russian)

It was established that the decay time of calcium strontium sulfide activated with bismuth is greatly lengthened by small lead additions. The conditions for the preparation of this phosphor were determined, and its characteristic properties were measured. The decay time of this luminophor is much longer than that of previously known long-lived phosphors. (tr-auth)

30870 THE COMPLETE FUEL ELEMENT RUPTURE DETECTOR OF THE MARCOULE G-3 REACTOR. Jean-Marie Servent (Department Nucleaire de l'Electronique Appliquée, Paris). Inds. atomiques, 5: No. 5-6, 129-33 (1961). (In French)

The fuel elements of the G-3 Reactor are clad with magnesium. As a result of corrosion and thermal cycling, ruptures occur. Because of possible contamination, it is necessary to detect this rupture, to locate the ruptured element, and to follow the evolution of the rupture so that the rod may be removed when the dimensions of the rupture are large enough. The complete detector used for this purpose in the G-3 Reactor is described in detail. The method of detection, the principle of the exploitation, and the principle of the measurement are discussed. (J.S.R.)

30871 OSCILLOGRAPHIC MEASUREMENTS IN THE NANOSECOND RANGE. R. Wahl. Inds. atomiques, 5: No. 5-6, 134-6(1961). (In French)

Two systems used for measurements in the nanosecond range—the cathodic tube with progressive waves and the sampling oscillograph—are described. The advantages and disadvantages of the two systems with respect to sensitivity, imput impedance, scanning speeds and the rate of repetition, and the operating reliability are discussed. (J.S.R.)

30872 MOISTURE MEASUREMENTS ON FINE-GRAINED SUBSTANCES WITH RADIOACTIVE ISOTOPES. H. Cermak (Institut für Baustoffe, Weimar, Ger.). Isotopentechnik, 1: 140-1(May 1961). (In German)

After a description of both methods for moisture measurements (slowing down of fast neutrons and γ absorption), the sources of error in the methods were discussed. (tr-auth)

30873 AN IONIZATION DETECTOR FOR GAS CHROMATOGRAPHY. H.-K. Bothe (Institut für angewandte Radioaktivität, Leipzig). Isotopentechnik, 1: 163-4(May 1961). (In German)

After a discussion of the application and operation of the ionization detector, a detector with Sr^{90} is described. The possibilities for further development are indicated. (tr-auth)

30874 ON SOME EFFECTS OF X AND γ RAYS ON THE RESISTIVITY OF CdS CRYSTALS. M. A. Talibi and A. G. Yusifov. Izvest. Akad. Nauk Azerbaidzhan S.S.R. Ser. Fiz. Mat. i Tekh. Nauk, No. 6, 91-7(1960). (In Russian)

The influence of various intensities of x and γ radiation on the resistivity of CdS monocrystals was studied in 20 specimens in order to evaluate its use as a dosimeter. The results indicated that CdS cannot be utilized because its sensitivity varies with both dose and radiation. (R.V.J.)

30875 VACUUM CHAMBERS FOR MEASURING LARGE X RADIATION DOSES. F. N. Kharadzha (Ul'yanov (Lenin) Leningrad Electrotechnical Inst.). Izvest. Vysshikh Ucheb. Zavedenii, Priborostroenie, 4: 99-104(1961). (In Russian)

Descriptions are given by two vacuum chambers for measuring large doses of x radiation: the diaphragm vacuum chamber for measuring weak radiation and the thimble-type for strong radiation. The latter, combined with an electrometric device or with a photomultiplier, can be utilized as a direct-reading r-meter. Chamber specifications are included. (tr-auth)

30876 INCREASED SENSITIVITY X-RAY DOSIMETER RM-1. V. A. Petrov, N. M. Palladieva, and P. S. Pivanova (Ul'yanov (Lenin) Leningrad Electrotechnical Inst. and Central Scientific-Research Inst. of Medical Radiology, USSR). Izvest. Vysshikh Ucheb. Zavedenii, Priborostroenie, 4: 105-10(1961). (In Russian)

Improvements in voltmeter design and the use of a special thin-walled chamber increased the sensitivity of r-meters to low-intensity x radiation. (R.V.J.)

30877 POSSIBILITY OF A SPIN WAVE MAGNETIC–MOMENT DETECTOR. T. B. Day and J. Sucher (Univ. of Maryland, College Park). J. Appl. Phys., 32: 1788-9(Sept. 1961).

A search was made for cooperative phenomena which could enhance weak magnetic moment interactions. It was conjectured that by using the magnetic fields of the Cherenkov effect to generate spin waves, which would in turn enhance the magnetic field, it might be possible to "ring" the system at some resonant frequency and thus perhaps see the changing magnetic fields of the whole cooperative system. To study these possibilities, the solutions of the combined Maxwell and spin-wave equations giving changes in magnetic fields and magnetization due to the presence of external currents were obtained by Fourier analysis. Results are intuitively plausible but inconclusive except that it was shown that the enhancement is independent of the nature of the source and that the question of background from charged particles in a neutral particle detector and the possibilities of using charged particles themselves as probes require futher exploration. (L.N.N.)

30878 ZERO-CURRENT AND POLARITY-EFFECT OF IONIZATION CHAMBERS. Hatsumi Tatsuta and Kazuaki Katoh (Japan Atomic Energy Research Inst., Tokyo). J. At. Energy Soc. Japan, 3: 602-7(Aug. 1961). (In Japanese)

The zero-current and polarity-effect of ionization chambers were studied experimentally. The former turns out to be mainly from the contact potential difference between two electrodes. For the latter, it was found that the zero-current of the output electrical connector makes it most dominant under ordinary conditions. When it comes to lower pressure ($< \sim 1$ mmHg), the Taylor-Greening Effect becomes effective. An effective range is introduced to understand the characteristics of ionization current at the recombination region. (auth)

30879 GRID-CONTROLLED FINE-FOCUS GUNS FOR LONG-BEAM THROW. Aurelius Sandor (General Telephone & Electronics Labs., Inc., Bayside, N. Y.). J. Electronics and Control (1), 10: 325-40(May 1961).

After investigating the spot-reducing property of small control grid apertures, which contradicts the over-simplified theory, electrostatically and magnetically focused fine-spot guns were designed and built for 15 in. beam throw. A minimum useful virtual object size (virtual cathode), equivalent to the first crossover size of 0.0016 in. diameter, was derived from equivalent magnification conditions. With 20 kv acceleration, undeflected spots of 0.01 in. diameter at 100 μamp beam current were realized, while conventional grids produce about 0.03 in. spots. For beam currents below 50 μamp a very steep decrease of spot size occurred, while above 100 μamp a practically linear increase took place. Dynamic brightness conditions during scanning reduced the size further to about $\frac{1}{2}$. A double-beam gun is discussed as well as the use of irradiated small aperture-objects to be focused on the screen. (auth)

30880 MEASUREMENTS OF THE LIMITING IMAGE CURRENT DENSITY PRODUCED BY ELECTRON GUNS OF ROTATIONAL SYMMETRY. Hilary Moss (Westinghouse Electric Corp., Elmira, N. Y.). J. Electronics and Control (1), 10: 341-64(May 1961).

Detailed descriptions are given of experimental investigations on how closely an electron gun of rotational symmetry can focus an electron beam into an image having a peak density equal to the theoretical maximum defined by Langmuir. Particular stress is laid on the difficulty of making this study if the cathode is non-uniform in emission density or shows irregularities in emission velocity over its active surface. If the image is formed only by a ray pencil of sufficiently narrow angle (θ here approximately 2×10^{-3} radian or less), then for all practical purposes the measured density reaches the theoretical maximum. This result is substantially independent of grid bias or geometry. The value of θ at which the gun begins to fall appreciably below the theoretical performance diminishes as the current from the cathode is increased. No significant differences were found in the behavior of standard BaO/SrO cathodes and bariated nickel cathodes. In measurements, the 'axial' electron temperature corresponding to the slope of the retarding field line seems about 75°C higher than the thermocouple temperature of the base metal. (auth)

30881 MEASUREMENT OF MAGNETIC FIELD CONTOURS. R. Freeman (National Physical Lab., Teddington, Middx., Eng.). J. Sci. Instr., 38: 318-21(Aug. 1961).

A simple apparatus is used to plot the field contours of a laboratory magnet, even when the instability of the field in time is comparable with the variations in space. It consists of two super-regenerative oscillators which produce signals at the nuclear magnetic resonance frequencies of the proton samples in their tank coils. One sample is fixed while the second scans the magnetic field, and the field difference between the two probes is presented in frequency units on an electronic counter. The method can be extended to make the field mapping operation completely automatic. (auth)

30882 AUTOMATIC METHOD OF MAGNETIC FIELD CALIBRATION USING PROTON RESONANCE. A. Horsfield, J. R. Morton, and D. G. Moss (National Physical Lab., Teddington, Middx., Eng.). J. Sci. Instr., 38: 322-4(Aug. 1961).

A circuit is described which enables the automatic calibration of a magnetic field to be carried out. A marginal oscillator, frequency controlled by one of eleven quartz crystals mounted in a motorized turret tuner, detects nuclear magnetic resonance signals. These signals activate a pen recorder and also trigger a control circuit which advances the turret tuner to the next channel. (auth)

30883 IONIZATION MICRODETECTOR FOR CAPILLARY GAS-LIQUID CHROMATOGRAPHY ON PROMETHIUM-147 WITHOUT ADDITIONAL GAS ADMISSION. Yu. A. Frank and M. I. Yanovskii (Inst. of Physical Chemistry, Academy of Sciences, USSR). Kinetika i Kataliz, 2: 292-4(Mar.-Apr. 1961). (In Russian)

Descriptions are given of a modified microionization detector with Pu^{147} for use in capillary gas-liquid chromotography. The detector volume is 5 to 7 mm^3, and sensitivity in 10^{-10} mole with a load resistance of 15 MΩ. (tr-auth)

30884 SEMICONDUCTOR NUCLEAR SPECTROMETERS. Tibor Fényes (Inst. of Nuclear Research, Hungarian Academy of Sciences, Debrecen). Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrecen), Közlemények, 3: 43-54(1961). (In Hungarian)

After a historical review of α-radiation detectors using semiconductors such as the half-n, half-p type semiconducting Ge based on the establishment of a voltage difference resulting from the diffusion of the voids, the physical principles of the detection mechanism and the characteristics of the detectors built are discussed. Recently the energy of β-particles up to 100 to 150 kev was successfully determined by means of p-type semiconductors with high specific resistivity. Progress was made in the measurement of the energy of γ-photons but the currently available instruments are in general not sensitive to individual photons. The semiconducting device is comparable to an ionization chamber operating on the electron collection principle but it presents the advantage of not requiring high voltage; its construction is simplified by the fact that the gas purification train is omitted. The energy discrimination is better but the detecting surface is smaller than that of the ionization chambers. It is well suited for determination of fission products, α-γ coincidence measurements, and for the study of the fine structure. (TTT)

30885 CORONA STABILIZER TUBE. Éva Csongor (Inst. of Nuclear Research, Hungarian Academy of Sciences, Debrecen). Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrecen), Közlemények, 3: 55-7(1961). (In Hungarian)

Various types of corona stabilizing tubes were prepared in the Nuclear Research Institute on the basis of previously published data resulting in a broad experience in the fields of application of the tube. Of the types used the 1-cm diameter cathode and 1-mm diameter anode tubes were found to be the most satisfactory ones. The tubes were filled with spectroscopically pure H_2. Any stabilizing tension between 350 and 2000 v may be achieved by a suitable adjustment of the gas pressure. Keeping the resistivity of the tube at 80 kΩ and choosing an external resistance of about 5 MΩ a stabilizing ratio of 1 : 100 could be reached. With increasing resistance the degree of stabilization but also the necessary input voltage will increase. For best results the

tube must be operated at a voltage yielding a current of about 70 to 80 μ amp, being thus placed at the steep portion of the characteristic curve. (TTT)

30886 IRRADIATED LITHIUM FLUORIDE AS AN OPTICAL FILTER IN THE FAR ULTRA-VIOLET. J. L. Weeks, S. Gordon, and G. M. A. C. Meaburn (Argonne National Lab., Ill.). Nature, 191: 1186-7(Sept. 16, 1961).

Irradiations were carried out with a high-intensity cobalt-60 source at several dose rates. An increase in absorption was found at 1849 and 2537 Å, and a decrease in transmission, due to the tail of the F-band, was found at 1849 Å. After irradiation the crystals were exposed to a high-intensity mercury resonance lamp for various times, and it was found that the rate of bleaching of the F-centers was low enough to allow the crystals to be used as filters. The experimental results for a typical filter are tabulated. (P.C.H.)

30887 AN INTENSITY CALIBRATION OF THE TWO METRE CURVED-CRYSTAL SPECTROMETER. W. F. Edwards, J. W. M. Dumond, and F. Boehm (California Inst. of Tech., Pasadena). Nuclear Phys., 26: 670-80(1961). (In English)

The 2-m curved-crystal diffraction spectrometer at the California Institute of Technology was calibrated to permit precise relative intensity measurements of gamma rays or x rays over the energy range 60 to 400 kev. The curved quartz crystal (2 mm thick, (310) planes) was found to have a dependence of reflectivity I/I_u upon energy E given by $I/I_u = (E_0/E)^{1.987 \pm 0.022}$, where E_0 is a reference energy within the range of the calibration. The relative intensity uncertainty, from sources other than counting rare statistics, is now of the order of 3% or less for gamma rays differing in energy up to a factor of four. (auth)

30888 A TRIGGER COUNTER WITH SUPPLEMENTARY ELECTRODE NEAR THE ANODE. Richard Pross (Universität, Tubingen, Ger.). Nukleonik, 3: 98-101(July 1961). (In German)

In the last few years investigations have been undertaken by various authors to obtain information or to improve the characteristics of counters by introducing a supplementary electrode between the cathode and anode of a trigger counter. Whereas these electrodes used had the form of a grid, in the present study the utility of a less extensive supplementary electrode was investigated. It has the form of two wires stretched parallel to the anode wire, whose distance from the anode could be changed by means of two levers connected to the counter ends from approximately 1 mm up to almost the complete counter radius. Since the voltage pulse occurring in a discharge on the supplementary electrode can be seen on an oscillograph, it was possible, by measurements at various positions of the supplementary electrode, to obtain a picture of the time pattern of the maximum of the charge density of positive ions and therefore a picture of the migration to the cathode. In further experiments the supplementary electrode was established at a predetermined potential. The distortion of the electrical field occurring affects the discharge since the range of existence of the ion column is narrowed. The resulting effect on the number of ion pairs was followed. A decrease of the counting rate at constant irradiation was observed together with a decrease of the number of ions. The decrease in the counting rate was traced back partly to a decrease of the corresponding probability and partly to a decrease of the number of secondary pulses. (tr-auth)

30889 METHOD FOR EVALUATING BUBBLE CHAMBER PICTURES. (Review). S. Ya. Nikitin. Pribory i Tekh. Ekspt., 6: No. 2, 5-13(Mar.-Apr. 1961). (In Russian)

A review is given of the method and instruments for automatic recording, measuring, and evaluating bubble chamber photographs. (R.V.J.)

30890 LARGE BETA SPECTROMETER WITH DOUBLE FOCUSING. O. D. Kovrigin, N. V. Kolesnikov, and G. D. Latyshev (Inst. of Nuclear Physics, Academy of Sciences, Kazakh, SSR). Pribory i Tekh. Ekspt., 6: No. 2, 19-25 (Mar.-Apr. 1961). (In Russian)

Descriptions are given of a double-focusing β spectrometer with equilibrium orbit radius $r_0 = 500$ mm. The resolving power of the spectrometer varies from 0.5 up to 0.08% with a variation of the solid angle from 0.65 to 0.15%, respectively. The profile of the interpolar slit is sufficient for Pavinskii field ($\beta = \frac{1}{8}$). (tr-auth)

30891 ANALYSIS OF ELECTRON TRAJECTORIES IN AXIAL β SPECTROMETER WITH CENTRAL SOURCE. V. N. Lukashev (Military Artillery Engineering Academy, USSR). Pribory i Tekh. Ekspt., 6: No. 2, 26-32(Mar.-Apr. 1961). (In Russian)

The expediency of utilizing potential models in the analysis of conditions and properties of equilibrium electron motion in an axial magnetic field is discussed. Potential curves, spiral trajectories, and parameters are found for unstable equilibrium orbits for variously accelerating axial fields. It is shown that the spiral trajectories can be achieved only near the symmetry plane of the axial field decelerating as R_0/r. (R.V.J.)

30892 DOUBLE FOCUSING IN A WIDE RANGE OF ENERGIES BY MEANS OF HOMOGENEOUS SECTOR MAGNETIC FIELDS. V. F. Litvin (Radium Inst., Academy of Sciences, USSR). Pribory i Tekh. Ekspt., 6: No. 2, 33-4(Mar.-Apr. 1961). (In Russian)

A double-focusing scheme is suggested for simultaneously recording particles in the interval $E_{min} < E < E_{max}$. (R.V.J.)

30893 SINGLE-CRYSTAL SCINTILLATION SPECTROMETER FOR FAST NEUTRONS WITH DISCRIMINATION FOR γ RAYS ACCORDING TO DE-EXCITATION TIME. V. A. Dulin, Yu. A. Kazanskii, V. F. Kuznetsov, and G. N. Smirenkin. Pribory i Tekh. Ekspt., 6: No. 2, 35-41(Mar.-Apr. 1961). (In Russian)

An analysis is made of the characteristics of a single-crystal scintillation spectrometer with γ-ray discrimination for measuring neutron energy distributions. The spectrometer is highly efficient, possesses satisfactory resolving power, has large dynamic range, and is practically insensitive to γ rays. The performance of the spectrometer is demonstrated by controlled measurements of Po–B and Po–Be neutron sources and U^{235} fission neutrons. (tr-auth)

30894 GAMMA SPECTROMETER WITH ORGANIC SCINTILLATOR CAPABLE OF TIME RESOLVING SELECTION OF γ RADIATION. R. I. Veretennikov, V. Ya. Averchenkov, M. V. Savin, and Yu. A. Spekhov. Pribory i Tekh. Ekspt., 6: No. 2, 42-6(Mar.-Apr. 1961). (In Russian)

Descriptions are given of a γ spectrometer capable of selecting γ quanta with resolving time ~1 nsec and operating with plastic scintillators. The resolving time for Cs^{137} γ quanta is ~25%. For the NaI(Tl) crystal the resolving time is ~4 nsec at 90% efficiency counting the Co^{60} γ quantum coincidences. (tr-auth)

30895 TELESCOPE OF SPARK COUNTERS IN MAGNETIC FIELD FOR MEASURING PULSES OF FAST CHARGED PARTICLES. M. I. Daion, V. Kh. Volynskii, and L. T. Potapov (Inst. of Physics., Academy of Sciences,

USSR). Pribory i Tekh. Ekspt., 6: No. 2, 47-51(Mar.-Apr. 1961). (In Russian)

A new telescope consisting of plane-parallel spark counters in a magnetic field for measuring pulses of fast charged particles ($\sim 10^{10}$ to 10^{11} ev/s) is described. (R.V.J.)

30895 THEORY OF SCINTILLATION DETECTOR ENERGY RESOLUTION. A. M. Ratner and I. A. Rom-Krichevskaya (All-Union Scientific Research Inst. of Chemical Reagents, Khar'kov). Pribory i Tekh. Ekspt., 6: No. 2, 53-6(Mar.-Apr. 1961). (In Russian)

The blurred photopeak caused by nonuniform light yield in the scintillator is investigated. Calculations are made of the crystal light collection from the polished surface. The curve distributions are evaluated by the pulse amplitudes at the photomultiplier exit considering the light response and photomultiplier spread. (tr-auth)

30897 IONIZATION MEASUREMENTS IN PHOTOEMULSION. A. O Vaisenberg, E. D. Kolganova, N. V. Rabin, and E. A. Pesotskaya. Pribory i Tekh. Ekspt., 6: No. 2, 57-9(Mar.-Apr. 1961). (In Russian)

The feasibility of measuring the density effects in photoemulsion is investigated. The relativistic growth maximum is equal to 13%. (tr-auth)

30898 THE DEPENDENCE OF DISTORTIONS AND PSEUDO SCATTERING ON THE ANGLE OF INCIDENCE OF TRACKS IN NUCLEAR EMULSION. Shu-fen Wang, N. Dalkhazhav, R. M. Lebedev, and V. N. Strel'tsov (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekh. Ekspt., 6: No. 2, 60-2(Mar.-Apr. 1961). (In Russian)

The distortions and pseudoscattering were studied as functions of the angle of incidence of charged particle tracks in NIKFI-P photoemulsion. The measurements were made of the tracks with angle of incidence 0.5°, 1.2°, 2.1°, 2.9°, 5.6°, and 10°. The distortions become evident at angles of incidence >3° and are fundamentally S shaped. The observations did not find any dependence between the pseudoscattering and the angle of incidence at 0 to 10°. The ratios are developed between second, third, and fourth co-ordinate differences for pseudoscattering. (tr-auth)

30899 AUTOMATIC SCANNING OF NUCLEAR EMULSIONS BY MEANS OF TELEVISION GRATING. A. E. Voronkov, A. I. Galaktionov, I. D. Murin, L. V. Sukhov, and I. V. Shtranikh (Inst. of Physics, Academy of Sciences, USSR). Pribory i Tekh. Ekspt., 6: No. 2, 63-8(Mar.-Apr. 1961). (In Russian)

An instrument designed for automatic scanning of tracks in nuclear emulsions is capable of measuring the scattering and track ionization and automatically recording the increment of co-ordinates x, y, and z of the selected track. (tr-auth)

30900 SEMI-AUTOMATIC MEASURING DEVICE FOR PROCESSING BUBBLE CHAMBER AND WILSON CHAMBER PICTURES. E. Fen'vesh, T. Gemeshi, F. Nemet, T. Shandor, L. Gasiorovski, and A. Starzhinski (Central Research Inst. of Physics, Budapest). Pribory i Tekh. Ekspt., 6: No. 2, 68-72(Mar.-Apr. 1961). (In Russian)

The design and operation of a semiautomatic measuring device for fast and accurate processing of pictures developed in bubble chambers and Wilson chambers are described. The instrument reduces the processing time by a factor of ten. (R.V.J.)

30901 GONIOMETER FOR LARGE CRYSTAL ORIENTATION USED IN NEUTRON MONOCHROMATIZATION. P. Sabo and E. Kren (Central Scientific-Research Inst. of Physics, Academy of Sciences, Budapest). Pribory i Tekh. Ekspt., 6: No. 2, 76-7(Mar.-Apr. 1961). (In Russian)

A special goniometer was constructed for checking the performance of crystal-monochromators used in neutron diffractometers and spectrometers, as well as in determining crystal orientation. (R.V.J.)

30902 MEASUREMENTS OF SCREEN TRANSPARENCY IN PULSED IONIZATION CHAMBERS. A. A. Vorob'ev and V. A. Korolev (Leningrad Inst. of Physics and Tech.). Pribory i Tekh. Ekspt., 6: No. 2, 78-80 (Mar.-Apr. 1961). (In Russian)

A method is suggested for measuring the transparency coefficient of shielding screens used in ionization chambers. The method is based on Green's reciprocity theorem and is accurate up to 3 to 5%. The data are correlated with published analytical calculations for plane screens. (tr-auth)

30903 SCINTILLATION DETECTOR FOR DISCRIMINATION RECORDING OF HEAVY AND LIGHT IONIZING PARTICLES. V. N. Bochkarev and V. V. Nefedov (Inst. of Physics, Academy of Sciences, USSR). Pribory i Tekh. Ekspt., 6: No. 2, 80-1(Mar.-Apr. 1961). (In Russian)

A design is given for a scintillation detector with a device for discrimination recording of electrons and heavy particles. The detector is capable of recording separately γ rays and neutrons. Measurements with a Po–Be neutron source and a γ source showed that the detector is capable of recording neutrons at over 1-Mev energy without losing the count of 3-Mev recoil protons. Without the device the efficiency of γ recording is reduced 1.5×10^{-6} N : 1, where N is the number of pulses recorded per second. The detector operates at a load up to 2×10^3 pulse/sec. Stilbene and naphthaline with anthranilic acid were used in discrimination γ-ray recording. (R.V.J.)

30904 SILICON p–n COUNTER FOR HEAVY CHARGED PARTICLES PERFORMING WITHOUT SOURCE SUPPLY. N. A. Vitovskii, P. I. Maleev, O. A. Matveev, S. M. Ryvkin, and D. V. Tarkhin (Inst. of Physics and Tech., Academy of Sciences, USSR). Pribory i Tekh. Ekspt., 6: No. 2, 82-3 (Mar.-Apr. 1961). (In Russian)

The performance of silicon n-p counters with short-circuit valve was tested at room temperature. The pulse amplitude for valve-type and photo-diode-type p-n counters irradiated with 5-Mev α particles is 2 to 3 mv. The rate of the pulse front for various specimens is 1 to 5 μsec. A drop in temperature does not affect the counter performance. (R.V.J.)

30905 TIME ANALYZER WITH A "GRAY WEDGE." O. B. Likin and O. M. Kovrizhnykh (Inst. of Chemical Physics, Academy of Sciences, USSR). Pribory i Tekh. Ekspt., 6: No. 2, 91-7(Mar.-Apr. 1961). (In Russian)

A scheme is suggested for an analyzer with a "gray wedge," for investigating electrical pulse time distributions at a time range from 10^{-1} to 10^{-5} sec. Results of the performance in measuring Pb^{205m} γ radiation are presented, and a calculation method for final numerical results is given. (R.V.J.)

30906 PRODUCING NANO-SECOND PULSES. V. S. Nadezhdin (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekh. Ekspt., 6: No. 2, 102-4(Mar.-Apr. 1961). (In Russian)

A method is described for producing double pulses with reduced pulse time. The resolving coincidence time of the scheme with a photomultiplier operating with a synchrocyclotron proton beam is about 2 fold less than the resolving time of the ordinary pulse formation and is 2.8 nsec. (tr-auth)

30907 AMPLIFYING DEVICE FOR SHORT PULSE RECORDING. A. I. Veretennikov, V. Ya. Averchenkov,

A. G. Egorov, and Yu. A. Spekhov. Pribory i Tekh. Ekspt., 6: No. 2, 104-9(Mar.-Apr. 1961). (In Russian)

Amplification cascades for nanosecond pulses are described. An amplification coefficient of 10 to 15 and a filtering band up to 200 M Hertz produce output voltages of several hundred volts for positive pulses. The design is given of amplification devices for oscillographs of short pulses in low-sensitivity electron-beam tubes. (R.V.J.)

30908 VACUUM DISCHARGER WITH ELECTRON IGNITION. V. V. Sokol'skii, A. I. Nastyukha, and E. A. Lobikov. Pribory i Tekh. Ekspt., 6: No. 2, 132-3(Mar.-Apr. 1961). (In Russian)

The construction is given of a vacuum discharger for switching high-pulse voltages of 0.3 to 12 kw. The maximum pulse time is 600 μsec. The discharger interelectrode area is excited by an electron beam from a low-voltage oscillating pulse discharge. (R.V.J.)

30909 RECTANGULAR WILSON CHAMBER. I. P. Yavor (Inst. of Physics and Tech., Academy of Sciences, USSR). Pribory i Tekh. Ekspt., 6: No. 2, 169(Mar.-Apr. 1961). (In Russian)

A rectangular 50 × 50 × 20 cm Wilson chamber with a rubber diaphragm operating without a controlling expansion mechanism is suggested. The chamber performs at 1.2 to 1.5 atm. pressure with overcompression and has a dead time of ~30 sec. (R.V.J.)

30910 FAST ELECTROHYDROEXPLOSION RELEASE VALVE FOR WILSON CHAMBER. V. F. Vishnevskii and V. V. Ekaterinini (Inst. of Nuclear Physics, Academy of Sciences, Kazakh SSR). Pribory i Tekh. Ekspt., 6: No. 2, 170(Mar.-Apr. 1961). (In Russian)

Descriptions are given of a fast-acting electrohydroexplosion release valve with opening time $<5 \times 10^{-4}$ sec. The valve is useful with Wilson and bubble chamber operations. (R.V.J.)

30911 MEASUREMENTS OF THE DEGREE OF NEUTRON POLARIZATION. A. D. Gul'ko (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR). Pribory i Tekh. Ekspt., 6: No. 3, 40-4(May-June 1961). (In Russian)

Measurements of the degree of neutron polarization by means of a depolarizing metal disk and double reflection are analyzed. The use of cobalt mirrors as polarizers and analyzers is investigated. A method is given for evaluating small angle scattering with a depolarizing plate. (R.V.J.)

30912 SCINTILLATION GAMMA SPECTROMETER FOR MEASURING EMISSION COINCIDENCES. A. S. Melioranskii (Moscow State Univ.). Pribory i Tekh. Ekspt., 6: No. 3, 44-9(May-June 1961). (In Russian)

The design is given of a γ spectrometer operating on the slow-fast coincidence principle. A single channel analyzer with smooth gate control from 0 to 25 v and a dead time of 1.5 μsec performs at coincidence with a resolving time of (5 to 8) 10^{-8} sec with 100% efficiency. The device is designed for operation at 10^5 pulse/sec, and was used in studies of (n,γ) reactions. (R.V.J.)

30913 SCINTILLATION FAST NEUTRON SPECTROMETER WITH BORON-ORGANIC SCINTILLATOR. E. L. Stolyarova, E. A. Kramer-Ageev, and G. A. Fedorov (Moscow Engineering and Physics Inst.). Pribory i Tekh. Ekspt., 6: No. 3, 49-51(May-June 1961). (In Russian)

A short description is given of the construction and efficiency of a fast neutron spectrometer. The efficiency for Po–Be neutrons is 0.05%. (tr-auth)

30914 DEVELOPMENT OF BUBBLE CHAMBER PHOTOGRAPHS. E. M. Andreeva, P. Girshl, I. A. Zarubin, G. M. Kadykov, S. M, Korenchenko, V. M. Lachinov, A. G. Morozov, K. G. Nekrasov, R. Poze, M. I. Popov, V. V. Smirnov, and N. S. Tolstoi (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekh. Ekspt., 6: No. 3, 52-60(May-June 1961). (In Russian)

A device for automatically developing bubble chamber pictures is described. The order of accuracy of coordinate measurements is 2 to 4 μ. The scanning rate is 3 mm/sec. Track coordinates can be fed directly into a computer for mathematical analysis. (R.V.J.)

30915 4 π-COUNTER WITH A MINIMUM BACKGROUND. V. A. Yurgenson (Radium Inst., Academy of Sciences, USSR). Pribory i Tekh. Ekspt., 6: No. 3, 60-3 (May-June 1961). (In Russian)

The construction and performance of a 4π-proportional counter capable of measuring source activity at 3 to 5 fission/min and safe without special shielding up to ~10 fission/min are described. The source area is 1 cm^2. (R.V.J.)

30916 DIFFERENTIAL METHOD OF DETERMINATION OF γ COUNTER EFFICIENCY. P. S. Baranov, L. I. Slovokhotov, G. A. Sokol, and L. N. Shtarkov (Inst. of Physics, Academy of Sciences, USSR). Pribory i Tekh. Ekspt., 6: No. 3, 63-6(May-June 1961). (In Russian)

A method based on proton and γ coincidences from neutral meson photoproduction in hydrogen is suggested for determining counter sensitivity to photons of 10 to 100 Mev. Counter efficiency for 30 to 160 Mev photons, with resolving power of ~ 20%, was determined. (R.V.J.)

30917 SCINTILLATION COUNTER FOR FAST NEUTRONS WITH LOW γ BACKGROUND SENSITIVITY. G. G. Doroshenko and E. L. Stolyarova. Pribory i Tekh. Ekspt., 6: No. 3, 69-71(May-June 1961). (In Russian)

The design and performance of a fast neutron scintillation detector with low sensitivity to γ background are described. The counter operates on the principle of neutron and γ pulse separation by a space charge photomultiplier. The efficiency of the counter for Po–Be neutrons is 7% with a stilbene crystal (ϕ 30 mm, h = 30 mm). The efficiency of γ recording is 0.01%. The permissible load (the integral neutron and γ quanta count without cutting off γ background) is 10^4 pulse/sec. (R.V.J.)

30918 AMP-VOLT CHARACTERISTICS OF CYLINDRICAL IONIZATION CHAMBER FILLED WITH AIR AT ATMOSPHERIC PRESSURE. V. S. Shevyrev and A. B. Dmitriev. Pribory i Tekh. Ekspt., 6: No. 3, 75-8(May-June 1961). (In Russian)

Amp-volt characteristics of cylindrical ionization chambers at ionization up to 10^5 r/hr were studied and correlated with published formulas. (R.V.J.)

30919 CORRECTIONS FOR NON-LINEAR SCALE OF NUCLEAR RADIATION RATE METERS. A. A. Bragin (Inst. of Mechanics and Automatization, Academy of Sciences, USSR). Pribory i Tekh. Ekspt., 6: No. 3, 82-3 (May-June 1961). (In Russian)

A calibration scale for rate meters is integrated for dead-time in certain elements of the measuring chain. A design is given for a linear integrator for gas discharge counters. (R.V.J.)

30920 TWO-CHANNEL PULSE INTEGRATOR WITH DECIMAL RECORDING SYSTEM. D. G. Borisov. Pribory i Tekh. Ekspt., 6: No. 3, 84-6(May-June 1961). (In Russian)

A two-channel pulse integrator was designed with common blocks for number setting, indication, and correction. The number-setting block records any number from 0 to 9999 in

the channel cells before reading the pulses. The recording system checks the numbers, the pulse reading, and performance of each channel. A decade scaler is connected to both channels. The device is capable of switching off the source after collecting the programmed number (within a limit of 10000). (R.V.J.)

30921 NANOSECOND PULSE GENERATOR WITH SMOOTH TIME CONTROL. O. S. Kolotov, Yu. N. Lebanov, and Z. Shil'berskii (Moscow State Univ.). Pribory i Tekh. Ekspt., 6: No. 3, 87-9(May-June 1961). (In Russian)

Descriptions are given of a generator of rectangular pulses with 1.2 kw maximum amplitude. Controlled pulses from 3 to 300 nanosec may be generated. (R.V.J.)

30922 FAST RASTER SCANNING. V. M. Gorbachev, N. A. Uvarov, and L. D. Usenko. Pribory i Tekh. Ekspt., 6: No. 3, 93-5(May-June 1961). (In Russian)

Raster scanning with a double-beam electron tube, producing continuous linear recording of high speed processes (up to 0.015 μsec/mm) with one-direction beam motion, is described. (R.V.J.)

30923 DEVICE FOR STUDYING OVERHAUSER EFFECT. A. V. Kessenikh (Moscow State Univ.). Pribory i Tekh. Ekspt., 6: No. 3, 107-10(May-June 1961). (In Russian)

An installation for studying dynamic hydrogen nuclear polarization at ~3000 gauss is described. A block diagram and the method of measurement are given. The results of an experiment in which a solid free radical polarization signal appears alongside the secondary signal (electron paramagnetic resonance) are discussed. (R.V.J.)

30924 AN INSTALLATION FOR STUDYING SPIN ECHO. V. I. Ermakov and V. M. Platonov (Moscow Inst. of Chemistry and Tech.). Pribory i Tekh. Ekspt., 6: No. 3, 110-14(May-June 1961). (In Russian)

A description is presented of an installation for observing spin echo signals. Specifications for the measuring device, the pulse generator for a wide-band amplifier, and the magnet current stabilizer are included. (R.V.J.)

30925 DETECTOR FOR RECORDING SMALL NUMBERS OF NEUTRONS IN PULSES. L. P. Bilibin and Yu. A. Zysin. Pribory i Tekh. Ekspt., 6: No. 3, 154-5(May-June 1961). (In Russian)

Single pulses of ~ 10^4 neutrons were detected by activating rhodium foil in a paraffin block. The sensitivity for five sources: Po–Be, Ra–Be, RaTh–Be, Ra–Be, and fission neutrons; and the spectral characteristics are plotted. The detector was used for measuring photoneutron pulses from a specimen exposed to γ radiation in a betatron. The order of accuracy at ~ 10^4 neutron/pulse is about 20%. (R.V.J.)

30926 ELECTRON MULTIPLIER TUBES WITH AXIALLY-SYMMETRIC 24 cm^2 ENTRANCE WINDOW. V. A. Ergakov, G. E. Levin, A. E. Melamid, Yu. V. Trebukhovskii, and N. S. Khleb'nikov. Pribory i Tekh. Ekspt., 6: No. 3, 157-9(May-June 1961). (In Russian)

An electron multiplier tube for recording wide nuclear recoil beams is described. The cathode and dinodes are of Al–Mg alloy with a Si admixture (0.2 mm and 0.1 to 0.12 mm thick respectively). Performance curves are included. (R.V.J.)

30927 SIMPLE NON-OVERLOAD AMPLIFIER FOR SCINTILLATION SPECTROMETRY. V. V. Trifonov (Radium Inst., Academy of Sciences, USSR). Pribory i Tekh. Ekspt., 6: No. 3, 160-1(May-June 1961). (In Russian)

A simple, 5-tube, non-overloading amplifier with amplification coefficient 2×10^3 is described. The overload coefficient is over 500. The amplifier utilizes 100 μ from a +250 v source and 25 μ from a –250 v source. Pulse intensities of electron stabilized sources do not exceed 50 mv with stabilized glow. Variations of the amplification coefficient (with voltage variation ±10%) do not exceed 0.2%. (R.V.J.)

30928 INSTRUMENT FOR PULSE AMPLITUDE MEASUREMENTS. V. K. Zlatarov. Pribory i Tekh. Ekspt., 6: No. 3, 161-3(May-June 1961). (In Russian)

A device for measuring pulses with an accuracy of ~0.3% is described. The device consists of a generator with two tubes and a Schmitt discriminator with an indicator. (tr-auth)

30929 STUDY OF A DIODE BRIDGE NANOSECOND RESOLUTION COINCIDENCE CIRCUIT. S. C. Pancholi and N. K. Saha (Univ. of Delhi). Proc. Natl. Inst. Sci. India. Pt. A, 27: 155-60(Mar. 26, 1961). (In English)

Detailed studies on a diode bridge nanosecond resolution coincidence circuit are described for different pulse amplitudes and pulse shapes. The shortest resolving time obtained with the circuit is 0.7 nanosecond. The circuit behaves in an extremely stable manner. (auth)

30930 A DIFFUSION CLOUD CHAMBER. P. I. Vatset, V. G. Vlasenko, V. I. Voloshchuk, G. A. Doroshenko, L. Ya Kolesnikov, V. O. (A.) Nikitin, and S. G. Tonapetyan (Khar'kov Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Ukrain. Fiz. Zhur., 6: 168-74(Mar.-Apr. 1961). (In Ukrainian)

A diffusion cloud chamber with a working diameter of 260 mm and a height of the sensitive layer of 60 mm is described. The chamber was tested at air pressures of 1 and 3.5 atm. Methyl alcohol was used as the evaporating liquid. The optimum temperature regime is: temperature of the chamber bottom, – 50°C to – 55°C; alcohol temperature, 20°C; average temperature gradient in the working region, 7° per cm. (auth)

30931 A LIQUID HYDROGEN BUBBLE CHAMBER. P. I. Vatset, V. I. Voloshchuk, L. Ya. Kolesnikov, V. O. (A.) Nikitin, and S. G. Tonapetyan (Khar'kov Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Ukrain. Fiz. Zhur., 6: 175-80(Mar.-Apr. 1961). (In Ukrainian)

The construction and working characteristics of a 500 cm^3 liquid hydrogen bubble chamber are described. The chamber worked satisfactorily within a temperature range of 27 to 30°K. This corresponds to a vapor pressure from 4.5 to 8 atm. The working cycle of the chamber is 2 sec. Photographs of the electron tracks produces by γ rays from Co^{60} were obtained. The expenditure of liquid hydrogen is about 0.5 liter per hour. (auth)

30932 11 LITER PROPANE BUBBLE CHAMBER. P. I. Vatset, V. I. Voloshchuk, L. Ya. Kolesnikov, V. O. (A.) Nikitin, and S. G. Tonapetyan (Khar'kov Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Ukrain Fiz. Zhur., 6: 182-5(Mar.-Apr. 1961). (In Ukrainian)

A description is given of a propane bubble chamber with a working volume of 340 × 204 × 160 mm. The principal scheme and the fundamental parameters are given. The possibility of illuminating the chamber with polarized light and photographing through the light analyzer is indicated. The chamber has a vacuum tube passing through the working liquid, in which the targets to be investigated can be placed. (auth)

30933 A METHANE DIFFUSION CLOUD CHAMBER FOR NEUTRON SPECTROMETRY. M. F. Vlasov, M. B. Fedorov, and V. P. Vertebnii (Kiev Inst. of Physics, Acad-

emy of Sciences, USSR). Ukrain. Fiz. Zhur., 6: No. 6, 186-90(Mar.-Apr. 1961). (In Ukrainian)

A diffusion cloud chamber filled with methane at normal pressure is described. The chamber may be used for fast neutron spectrometry in an energy range of 1 to 3 Mev. (auth)

30934 A REMOTE PROTON MAGNETOMETER. M. G. Afanasev, A. P. Vilyams (Williams), A. G. Gordienko, and L. I. Sidorenko (Khar'kov Inst. of Physics and Tech., Ukrainian SSR). Ukrain. Fiz. Zhur., 6: 191-6(Mar.-Apr. 1961). (In Ukrainian)

A magnetometer that serves as both a magnetic field measurer and an information generator for the automatic stabilization of powerful magnets is described. A distinguishing feature is that the whole magnetic field range from 1.5 to 12.5 kilogauss is covered with a single proton source placed at a considerable distance (1000 mm) from the point of generation. Remote measurement and remote automatic stabilization are effected. (auth)

30935 INVESTIGATION OF THE ELECTRON COMPONENT OF SINGLE AVALANCHES WITH THE PHOTOMULTIPLIER. Uwe Dibbern (Universität, Hamburg). Z. Physik, 163: 582-93(1961). (In German)

With a photomultiplier single electron avalanches of 10^3 carriers can be observed in nitrogen. 2.5% of all photons (in the range $3000 \leqq \lambda \leqq 7000$ Å) of an avalanche produce a photoelectron at the cathode of the photomultiplier. The influence of the variable solid angle on the photomultiplier pulse is given. Trouble by noise is calculated, and it is shown that the information depends on the number of photoelectrons only. The electron components of avalanches in methane, nitrogen, and mixtures have an exponential rise, and the measured rise time constant τ_{beob} is in accordance with the theoretical value $1/\alpha v_-$. For carrier numbers $>10^6$ space charge influence is observed, as given by theory. The quantum efficiency Q per ionizing impact is found to be $Q \sim 10^{-3}$ in vapors and $Q \sim 1$ in gases. Values of the electron drift velocity in mixtures of N_2 and CH_4 are given. (auth)

30936 REVERSIBLE LIGHT CENTER TRANSFORMATIONS IN ZnS PHOSPHORS. H. Blicks, N. Riehl, and R. Sizmann (Technische Hochschule, Munich). Z. Physik, 163: 594-603(1961). (In German)

There are two types of Cu light centers: the well-known green luminescing and a blue luminescing center. The latter corresponds with a double occupancy of the center with Cu. The transformation of one type into the other type can occur at very low temperatures, even at room temperature. The transformation process can be explained as dissociation or association processes, in which a Cu^+ ion diffuses into the interstices of the ZnS lattice. The dissociation energy for the transformation was determined to be 0.38 ev. (tr-auth)

30937 IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF SHEET MATERIALS. Sidney Walter Gough (to Dunlop Rubber Co., Ltd.). British Patent 877,685. Sept. 20, 1961.

A radiometric gage is designed for measuring the weight per unit area of thin films, e.g., rubber sheets. The gage comprises two sources of beta or gamma radiation, the first positioned to irradiate the feed material before it passes through the calendar and the second positioned to irradiate the worked material. Ionization chambers detect the scattered radiations, and the ionization current from the second source is compared with that from the first source which, being derived from a material of thickness greater than saturation thickness, is determined solely by the material composition. The gage may be used to maintain the worked material at a constant thickness. (D.L.C.)

30938 CORE SATURATION BLOCKING OSCILLATOR. R. J. Spinrad (to U. S. Atomic Energy Commission). U. S. Patent 3,005,158. Oct. 17, 1961.

A blocking oscillator which relies on core saturation regulation to control the output pulse width is described. In this arrangement an external magnetic loop is provided in which a saturable portion forms the core of a feedback transformer used with the thermionic or semi-conductor active element. A first stationary magnetic loop establishes a level of flux through the saturation portion of the loop. A second adjustable magnet moves the flux level to select a saturation point giving the desired output pulse width. (AEC)

30939 PRECISION INTEGRATOR FOR MINUTE ELECTRIC CURRENTS. Arthur Hemmendinger and Richard J. Helmer (to U. S. Atomic Energy Commission). U. S. Patent 3,005,950. Oct. 24, 1961.

An integrator is described for measuring the value of integrated minute electrical currents. The device consists of a source capacitor connected in series with the source of such electrical currents, a second capacitor of accurately known capacitance and a source of accurately known and constant potential, means responsive to the potentials developed across the source capacitor for reversibly connecting the second capacitor in series with the source of known potential and with the source capacitor and at a rate proportional to the potential across the source capacitor to maintain the magnitude of the potential across the source capacitor at approximately zero. (AEC)

Materials Testing

30940 (ARF-6043-17) ULTRASONIC METHODS FOR NONDESTRUCTIVE EVALUATION OF CERAMIC COATINGS. Quarterly Progress Report No. 4, April 1—June 30, 1961. W. E. Lawrie (Illinois Inst. of Tech., Chicago. Armour Research Foundation). July 14, 1961. Contract AF33(616)-6396. 25p.

A summary is presented of work conducted in developing ultrasonic methods for determining ceramic-metal bond strength and uniformity. Consideration was given to the differences between flame-sprayed and vapor-deposited coatings. Surface wave studies were divided into theoretical and empirical investigations. Apparatus to generate impact loads in the bonds were designed and constructed. Quartz crystals are to be used to detect the impact stresses and to determine bond conditions. A Schlieren system was constructed to permit more extensive use of higher ultrasonic frequencies. (B.O.G.)

30941 (MAB-176-M) EVALUATION TEST METHODS FOR REFRACTORY METAL SHEET MATERIALS. (National Research Council. Materials Advisory Board). Sept. 6, 1961. 22p.

Recommendations directed toward standardization of test procedures for refractory alloy sheet material are summarized. It is thought that the recommendations represent a practical compromise between a number of different approaches. (J.R.D.)

30942 (NP-10712) PORADNIK DEFEKTOSKOPII IZOTOPOWEJ. (Handbook on Isotopic Defectoscopy). (Poland. Biuro Urzadzen Techniki Jadrowej, Warsaw). [1961?]. 62p.

The book is designed for scientists and personnel handling radioisotopes in laboratories and industry. The technological procedures and apparatus for isotope production and applications are described. (R.V.J.)

30943 (NP-tr-748) TESTING OF WELDMENTS AT HIGH TEMPERATURES BY MEANS OF A COOLED CASSETTE. Ernst Schiebold and Egon Becker. Translated from Schweisstechnik (Berlin), 11: No. 4, 146-51 (1961). 18p.

A description is given of the design and operational characteristics of a cooled cassette for use in the hot-radiographic nondestructive testing of weldments and cast pieces, which allows the testing of the pieces without cooling to room temperature. The quality of the negative from the exposure made with the cassette showed no difference as compared with the usual x-ray film. Investigations of the texture showed no effect of the cooled cassette on the texture of the weldment. (B.O.G.)

30944 DISTRIBUTION FREE TESTS OF INDEPENDENCE BASED ON THE SAMPLE DISTRIBUTION FUNCTION. J. R. Blum, J. Kiefer, and M. Rosenblatt (Sandia Corp., Albuquerque, N. Mex.; Indiana Univ., Bloomington; Cornell Univ., Ithaca, N. Y.; and Brown Univ., Providence). Ann. Math. Statist., 32: 485-98(June 1961). (SCR-298)

The characteristic functions of the limiting distribution functions of a class of tests which have superior power properties in their independent components are obtained. The corresponding distribution function is tabled in the bivariate case, where the test is equivalent to one originally proposed by Hoeffding. A discussion is included of the computational problems which arise in the inversion of characteristic functions of this type. Techniques for computing the statistics and for approximating the tail probabilities are considered. (N.W.R.)

30945 EARLY FAILURES IN LIFE TESTING. Rupert G. Miller, Jr. (Sandia Corp., Albuquerque, N. Mex.). J. Am. Statist. Assoc., 55: 491-502(Sept. 1960). (SCR-261)

Data from certain life test experiments exhibit such an unusually high concentration of failures near time 0 that the assumption of an over-all exponential density is unwarranted. One hypothesis for this phenomenon is that due to faulty construction or defective parts, certain test items fail prematurely; these items are termed early failures. To handle this type of data, an early failure model is postulated in which one failure rate is assumed to be in effect for an initial time interval $(0,T_0)$ and another, lower failure rate is operative thereafter. Estimators for the two failure rates are given in the case where T_0 is known and in the case where T_0 is not known exactly but can be assumed to be within a specified interval. Methods for obtaining approximate large sample confidence regions are outlined and procedures for handling small samples are described. (auth)

30946 DEVELOPMENT OF NONDESTRUCTIVE TESTS FOR THE EGCR FUEL ASSEMBLY. Robert W. McClung (Oak Ridge National Lab., Tenn.). Nondestructive Testing 19: 352-8(Sept.-Oct., 1961).

A brief introduction is made to the Experimental Gas-Cooled Reactor being constructed at Oak Ridge, Tennessee. The fuel assembly, its operating parameters, and each of its components are described. The development of the specific nondestructive techniques for the evaluation of the components and the fabricated fuel capsule is presented. These techniques include penetrants, pulse-echo and resonance ultrasonics, radiography, eddy currents, helium-leak testing, and others. The capabilities and limitations of these techniques are discussed relative to the specific inspection problems. Reasons are presented for the selection of the inspection requirements. (auth)

30947 INSPECTION OF THICK-WALLED OBJECTS BY γ-DEFECTOSCOPE WITH SCINTILLATION COUNTERS. V. N. Fainberg (Urals Chemical Machine Building Plant, USSR). Zavodskaya Lab., 411-13(1961). (In Russian)

Data are presented on defectoscope sensitivity, and the optimum signal-noise ratio is determined. Comparisons are made between the efficiency of the defectoscope and other industrial procedure. (tr-auth)

30948 INFLUENCE OF PHOTO-DEVELOPMENT ON THE CONTRAST AND DENSITY IN X AND γ DEFECTOSCOPY. V. S. Tokmakov (Bardin Central Scientific Research Inst. of Ferrous Metals, [USSR]). Zavodskaya Lab., 27: 479-80(1961). (In Russian)

The influence of various developers on the density and contrast of x and γ defectograms is analyzed. A hydrazine developer capable of increasing the image density by a factor of 2 to 3 and the contrast by a factor of 1.8 to 2.5 is recommended. (tr-auth)

30949 APPARATUS FOR NON-DESTRUCTIVE INSPECTION OF CANTILEVERED MEMBERS. E. R. Taylor, C. H. Mahoney, and C. R. Lay (to U. S. Atomic Energy Commission). U. S. Patent 3,005,334. Oct. 24, 1961.

An apparatus for non-destructive inspection of cantilevered members, such as compressor blades, is described. The member under inspection is vibrated with a regulated source of air under pressure. The amplitude of vibration of the member is maintained at its natural frequency. The frequency of vibration of the member is measured. An indication of an excessive decay or erratic shifting in the measured frequency above an allowable hysteretic decay is provided as an indication of a fault in the member. The member is vibrated for a selected test period. (AEC)

GEOLOGY, MINERALOGY, AND METEOROLOGY

Refer also to abstracts 30342 and 30545

30950 (AD-259665) A STUDY OF THE ELECTROSTATIC PRECIPITATION OF RADIOACTIVE AEROSOLS (thesis). Donald Leslie Lamberson (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio). Mar. 1961. 108p. (GNE/Phys/61-7)

The nature of long-lived fission product aerosols and the charging and collecting of these aerosols are studied in order to determine and increase an electrostatic precipitator's sensitivity, which is defined as the product of flow rate and efficiency. The fission products probably are homogeneously disbursed in carrier aerosols whose logarithm-radius distribution is from 0.1 to 10 μ radius and whose mean dielectric constant is about 4. Aerosol charging, which is most efficient in negative corona discharge, is accomplished by either ion bombardment or diffusion. Bombardment charge is the predominant mechanism for the particle sizes concerned. With both types of charging, the charge rate and total charge increase as the electric field and ion density increase. Charging is essentially complete in 10^{-2} sec when these parameters are maximized. The electric field in the collection section determines the drift velocity of an aerosol toward a collection electrode. Cylindrical and parallel-plate collection geometries are discussed. The conclusions from an analysis of a hypothetical, two-stage, parallel-plate precipitator are that the charging of aerosols can be accomplished in a fraction of total precipitator volume, the sensitivity of a precipitator cannot be increased by increasing the flow rate alone but must be accompanied by improvement in precipitator efficiency, increased precipitator efficiency may be obtained by either a higher charge distribution or a more efficient collection geometry, and the most difficult particle size to precipitate is 0.3 μ radius. (auth)

30951 (AEET/AM/20) GAMMA-RAY ANALYSIS OF FALLOUT SAMPLES COLLECTED IN INDIA DURING OCTOBER 1958 TO MARCH 1960. K. G. Vohra and V. S. Bhatnagar (India. Atomic Energy Establishment, Trombay). Nov. 1960. 20p.

Rain water samples collected at Bombay and Srinagar after the cessation of high-yield tests in October 1958 were analyzed to determine the concentrations of Zr^{95}, Ce^{144}, Ru^{106}, and Cs^{137}, using a low-level gamma scintillation spectrometer. During the period of highest fall-out in India, i.e., December 1958 to May 1959, the average monthly deposition rate of Cs^{137} was about 2.1 mc/km^2 at Srinagar. The data were used to estimate the infinity external γ radiation dose from Zr^{95}, Ce^{144}, Ru^{106}, and Cs^{137}. The total dose from these isotopes for the period October 1958 to June 1959 was about 50 mrem. The total dose during the period July 1959 to March 1960 was only 8 mrem. The large dose during the period October 1958 to June 1959 is attributed to shorter residence time of the debris injected in the polar regions during the USSR test series of October, 1958. (auth)

30952 (HW-70135) FEASIBILITY OF PRECIPITATION AND CLOUD SCAVENGING EXPERIMENTS AT HANFORD, AND PERTINENT CLIMATOLOGY. R. J. Engelmann (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 29, 1960. 43p. Contract AT(45-1)-1350.

The fluorescent tracer technique in use at Hanford, pertinent rain and fog climatology, and computations indicating that individual droplet efficiencies can be evaluated using the tracer technique are described. Atmospheric stabilities during precipitation, the precipitation rate, monthly precipitation, the diurnal variation of precipitation, fog climatology, precipitation and fog wind roses, and forecast capabilities are discussed. Because the collection by individual droplets permits extension of the results to all drop-size distributions, it was concluded that scavenging experiments should be designed to include sampling of individual droplets. (M.C.G.)

30953 (NP-10704) PARTICLE FALL RATE CALCULATION. Interim Report. M. L. Katz and R. R. Read (California. Univ., Berkeley. Inst. of Engineering Research). Apr. 15, 1959. Contract CD-SR-58-40. 17p.

An examination is made of present methods of calculating fall rates for irregularly shaped particles and it is pointed out that the methods are not reliable. Planned experimental work to rectify this situation is discussed. (auth)

30954 (NP-10816) TRANSITION FROM ELASTIC TO PLASTIC STATES OF ROCKS UNDER TRIAXIAL COMPRESSION. Progress Report No. 2. Shosei Serata (Michigan State Univ., East Lansing). [1961?]. 26p.

Presented at the 4th Symposium on Rock Mechanics, Pennsylvania State Univ., March 30–April 1, 1961.

A theory describing the mechanism of triaxial behavior of rocks in underground formations is developed for the purpose of analyzing underground stress conditions. A phenomenon of an abrupt transition from elastic to plastic states of rocks under triaxial compression is anticipated from the theory, which is verified by laboratory experiments simulating conditions in underground formations. Based on the theory and experimental results, a method for determination of static underground stress field is proposed, and the existence of the plastic state and the boundary of transition in underground formations are predicted. (auth)

30955 (RME-98(Rev.)) GEOLOGY OF THE GREEN RIVER MINING DISTRICT, EMERY AND GRAND COUNTIES, UTAH. R. G. Young, Isadore Million, and D. M. Hausen (Grand Junction Operations Office. Production Evaluation Div., AEC). Sept. 1960. 8p.

Uranium deposits have been known since the 1880's in the Green River district of eastern Emery County and western Grand County in southeastern Utah. Outcropping rocks include the Entrada sandstone and the Carmel, Curtis, Summerville, and Morrison formations of Late Jurassic age; the Cedar Mountain formation of Early Cretaceous age, the Naturita formation of probable Late Cretaceous age in this area, and the Mancos shale of Late Cretaceous age. Uranium is found chiefly in the Salt Wash sandstone member of the Morrison, and the largest deposits occur in a thick sandstone unit near the top of the member in the Tidwell mineral belt near the western edge of the district. The geology of the district is described in detail. (C.H.)

30956 (TEI-795) INTERIM REPORT ON SEISMIC VELOCITIES OF THE OAK SPRING FORMATION U12e AND U12b TUNNEL SYSTEMS, NEVADA TEST SITE, NYE COUNTY, NEVADA. R. M. Hazlewood (Geological Survey, Washington, D. C.). June 1961. 12p.

The seismic velocities obtained in a survey of part of the U12e and U12b tunnels at the Nevada Test Site, Nye County, Nev. are given. The tunnel systems penetrate tuffaceous rocks of the Oak Spring Formation of Miocene

or younger age. A 12-trace portable refraction seismograph was used to make the velocity measurements. The reversed profile method of shooting was used. The location of 14 seismic traverses in the U12e tunnel system and the 3 seismic traverses in the U12b tunnel system are shown. (M.C.G.)

30957 (TID-13669) GEOLOGIC ASPECTS OF THORIUM RECOVERY FROM COMMON ROCKS. Quarterly Progress Report, June 1, 1961—August 31, 1961, John A. S. Adams and John J. W. Rogers (Rice Univ., Houston, Tex.). For Oak Ridge National Lab., Tenn. Contract [W-7405-eng-26] Subcontract 1491. 48p.

Measurements and samples taken from southern lateritic soils indicated that they are very low in thorium (5 to 16 ppm). Over 500 field spectroradiometric determinations of thorium were made on the Conway granite and related rocks of the White Mountain Magma Series in New Hampshire. An accompanying map shows Conway granite contacts and locations of field thorium determinations. (M.C.G.)

30958 (WT-1702) EARTH MOTION MEASUREMENTS. L. M. Swift, D. C. Sachs, and W. M. Wells (Stanford Research Inst., Menlo Park, Calif.). Jan. 1961. Project 26.1 of Operation HARDTACK, Phase II. 108p.

Several parameters of ground motion on two deep underground nuclear detonations (Evans and Blanca) were measured. Primary measurements included vertical acceleration and velocity in a deep hole over Evans zero, horizontal and vertical acceleration on the mesa surface, and horizontal surface strain. Additional data were obtained on vertical response spectra (reed gage), surface subsidence (liquid level), and aftershocks (geophone listening). Most of the primary objectives were not fulfilled because of the low yield of Evans (30 + 15 −5 tons, 830-ft depth); only about one-third of the records of primary measurements are useful. For Blanca (19 kt at 830-ft depth from the nearest surface (slope)), the Evans gages were reactivated and usable records were obtained on about one-third of the primary measurements; also, the peak strain, liquid-level, and reed gages all performed effectively. Despite the less than satisfactory over-all results, some conclusions were drawn on the basis of the data obtained. Arrival time studies seemed to confirm earlier indications of a high speed layer in the Area 12 mesa at 300-ft depth. This layer was found to preclude general conclusions as to propagation mechanism or amplitudes measured at the surface. Subsurface motions although very small were consistent with scaling methods applied to prediction of Hardtack-II events. The cavity-size determination by geophysical methods was abandoned because of exigencies of the crowded shot schedule. In situ seismic propagation velocities in the earth near several underground shot chambers were measured for use in analysis of diagnostic measurements. (auth)

30959 (NP-tr-753) INVESTIGATIONS OF INHOMOGENEITIES IN THE IONOSPHERE. (Issledovaniya Neodnorodnostev v Ionosfere). Issue No. 4 of the IGY Series. Translated from a publication of the Publishing House of the Academy of Sciences, Moscow, 1960. 188p.

Nine articles are included covering the properties of inhomogeneities in the ionosphere ranging in dimension from tens of meters to hundreds of kilometers. The development of the three-point correlation method of measurement is reviewed, and an evaluation is made of the applicability of the three-point, space-diversity method for investigations of horizontal movements in the ionosphere. Results are included of investigations on the properties of large ionospheric inhomogeneities obtained by combined measurements of space-diversity and frequency-separation reception. The vertical dimensions of such inhomogeneities were determined and the presence of a large vertical component of drift velocity was established. Results are compared for investigations of the properties of small inhomogeneities by two methods. The role of diffusion processes in the ionosphere as a factor determining the life span of inhomogeneities of various dimensions is considered, and the results of simultaneous observations of large and small inhomogeneities, which demonstrate common features, are discussed. Results are also included from preliminary investigations on the polarization of radio waves and its influence on methods of observing ionospheric inhomogeneities, the use of the correlation method in studies on the properties of ionospheric inhomogeneities, and new points in ionospheric drifts. (C.H.)

30960 ISOTOPIC ANALYSIS OF LEAD. G. Buznea and C. Grigorescu-Sabau (Inst. of Nuclear Physics, Bucharest). Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz. Studii cercetări fiz., 12: No. 1, 79-86(1961). (In Rumanian)

The isotopic composition of seven specimens of ordinary lead (galena) and one specimen of monozite from north west Rumania was determined. The lead was studied as $PbCl_2$. It was found that galena has a normal isotopic composition and varies vary slightly. The age of the monazite was established as about 150 million years. (tr-auth)

30961 THE RATE OF MODERN AND LATE QUATERNARY SEDIMENTATION IN THE SOUTHERN PART OF THE PACIFIC BY RADIOCARBON DATING. I. E. Starik, A. P. Zharkov, and A. P. Lisitsyn (Khlopin Radium Inst., Academy of Sciences, USSR and Oceanoglogical Inst., Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 139: 970-3(Aug. 1, 1961). (In Russian)

Core samples were taken from the bottom of the Pacific Ocean at approximately 40° south latitude, and the age of these samples was determined by scintillation counting of the C^{14} content. A rate of sedimentation of 3 to 5 mm per 1000 years seems to be typical for the equatorial and tropic zones of the Pacific Ocean. The rate of deposition of a 11,000 year old layer in the Pacific Ocean had increased by a factor of 2 to 3. These data are in agreement with similar data obtained in the Atlantic and Indian Oceans. These data in the absolute age and rate of deposition of various sediments can be used to determine the absolute amounts of carbonaceous material which are deposited on the floor of the ocean each 1000 years. (TTT)

30962 RADIOACTIVITY OF BLACK SEA DEPOSITS. I. E. Starik, D. S. Nikolaev, Yu. V. Kuznetsov, and V. K. Legin. Doklady Akad. Nauk S.S.S.R., 139: 1456-9(Aug. 21, 1961). (In Russian)

The content of radium in ocean deposits varies from 4 to 50×10^{-12} g/g, while the radium content in Black Sea deposits is relatively constant at 5 to 9×10^{-13} g/g (substantially lower than in ocean deposits). The radium content does not vary with the height of the core sample. The absolute content of ionium varies from 0.8 to 5.8×10^{-10} g/g (approximately that found in ocean deposits) with the higher ionium values being found in the surface layers. Since the Black Sea deposits are relatively young in age, the amount of ionium is almost always greater than the amount of radium, and the ionium and radium are not in equilibrium with each other. The uranium content in Black Sea deposits is 1C to 12×10^{-6} g/g (5 to 7 times greater than the uranium con-

tent in typical ocean deposits). The surface layers of the core sample have a higher uranium content than the lower layers. The precipitation of uranium is favored by the reducing conditions prevalent in the Black Sea. The ratio of thorium to uranium is low in the upper layers of the core sample, but rises to a value that is more typical of ocean deposits in the lower layers of the core sample (Th/U > 3). For the last 1500 years the rate of deposition in the Black Sea is estimated at 36 to 60 cm per 1000 years. This high rate of deposition accounts for the deficiency of radium in the Black Sea deposits. (TTT)

30963 PROGRESS IN GEOCHEMICAL PROSPECTING METHODS. Shuji Ohashi (Atomic Fuel Corp., [Tokyo]) and Yukio Murakami. Genshiryoku Kôgyô, 6: No. 5, 41-7 (May 1960). (In Japanese)

The relatively low U content of the Japanese U deposits made it necessary to develop accurate prospecting methods and resulted in the application of geochemical prospecting. Methods based on fluorescence phenomena and on paper chromatography have been adapted for the direct detection of U with an accuracy of 10^{-10} in the river water and of 10^{-7} in the soil, rocks or plants. The method was used with excellent results for determining the extent of the Ningyo Toge deposits and contributed to the discovery of several other Japanese U deposits. (TTT)

30964 THE K/Cs RATIO IN SOME BASIC ROCKS. L. H. Ahrens and R. A. Edge (Univ. of Cape Town). Geochim. et Cosmochim. Acta, 25: 91-4(Sept. 1961). (In English)

Data on basic rocks and chondrites, which were analyzed by the ion exchange-spectrochemical method, are presented. A comparison of the data is made with previous results obtained by the same method on three basalt composites. With the exception of the average basalts, rock specimens are calibrated in terms of reference rock W-1, and the K/Cs ratios are directly comparable; the same applies to the chondrites. Dispersion was found to be comparatively small in the basic rocks, and most K/Cs ratios cluster about the average of 7500. (P.C.H.)

30965 VARIATION OF THORIUM AND URANIUM IN SELECTED GRANITIC ROCKS. John J. W. Rogers and Paul C. Ragland (Rice Univ., Houston, Tex.). Geochim. et Cosmochim. Acta, 25: 99-109(Sept. 1961). (In English)

A selected suite of granitic rocks representing both individual differentiation sequences and a broad sampling of granites from North America were analyzed for thorium, uranium, and potassium by γ-ray spectrometry. In the White Mountain and Oliverian series of New Hampshire both the thorium and uranium contents and the Th/U ratio tend to increase with igneous evolution. In the Southern California batholith the thorium and uranium contents increase during differentiation, but the Th/U ratio is constant. The general tendency for the Th/U ratio to increase with petrogenetic evolution is shown by a comparison of the Th/U ratio with the ratio of potassium feldspar to plagioclase for a broad sampling of granitic rocks. This increase is probably caused by oxidation during magmatic differentiation. (auth)

30966 THE LEAKAGE OF RADIOGENIC ARGON FROM SANIDINE. H. Baadsgaard, J. Lipson, R. E. Folinsbee (Univ. of Alberta, Edmonton, Can.). Geochim. et Cosmochim. Acta, 25: 147-57(Sept. 1961). (In English)

The effects of variable temperature and grain-size in short-term (days) tests of argon leakage from pure sanidines were investigated. The results indicate that the radiogenic argon is quantitatively retained at temperatures below 400°C except, possibly, for the finest grain-sizes (–325 mesh) and for sanidines with lattice irregularities. Argon loss above 400°C and below the melting temperature appears to involve the loss of at least two separate argon components for structurally inhomogeneous sanidine. Bentonitic sanidine (of homogeneous structure) showed only simple diffusion loss of argon. Argon loss from feldspars is discussed in terms of diffusion and lattice discontinuities. To test possible long term (millions of years) low-temperature losses of radiogenic argon from bentonitic sanidine, seven biotite–sanidine pairs, taken from bentonite clay horizons and ranging in age from ~65 to ~450 million years, were sampled and analyzed. The sets of Ar^{40}/K^{40} values obtained are the same within analytical error (±5%) over the entire range of ages and show that bentonitic sanidine radiogenic argon as well as comparable biotite. The data appear to indicate that fresh sanidine obtained from volcanic bentonite horizons retains radiogenic argon sufficiently well to yield reliable Ar^{40}/K^{40} ages. (auth)

30967 THEORY OF SIMILITUDE IN RESOLVING PROBLEMS ON DRILLED HOLE RADIOMETRY. Sh. A. Guberman (Inst. of Petroleum and Gas Industry, [USSR]). Izvest. Akad. Nauk S.S.S.R., Ser. Geofiz., No. 8, 1183-8(Aug. 1961). (In Russian)

The principle of similitude was used in the problem of particle transmission kinetics. The obtained results were applied in resolving a problem of neutron and γ distribution in holes in rocks. (R.V.J.)

30968 THORIUM CONTENTS OF SOME PITCHBLENDS FROM FRANCE. Kazuhisa Nozawa (Université, Nancy). J. At. Energy Soc. Japan, 3: 608-13(Aug. 1961). (In Japanese)

The thorium contents of some pitchblends from representative uranium ore deposits in France were quantitatively determined. The chemical analysis was effected by the anion exchange — TTA extraction — spectrophotometry by thoron method. The loss of thorium during the operations was evaluated using UX_1 as tracer. The thorium contents ranged from several ppm to the order of 10 ppm. Values which are not higher than those in granitic rocks show the immobility of thorium in the process of epihydrothermal mineralization of uranium in the granitic rocks. (auth)

30969 THE CONDUCTIVE 'CHAPMAN' LAYER. C. H. Cummack (Geophysical Observatory, Christchurch, N. Z.). J. Geophys. Research, 66: 2751-5(Sept. 1961).

The shape of the electron production function, when ionizing radiation acts as an atmospheric heat source, is given for atmospheres in mixed or diffusive equilibrium. (auth)

30970 A STATIC THEORY OF THE SEISMIC COUPLING OF A CONTAINED UNDERGROUND EXPLOSION. Norman A. Haskell (Air Force Cambridge Research Labs., Bedford, Mass.). J. Geophys. Research, 66: 2937-44(Sept. 1961).

According to the theory of Latter, Martinelli, and Teller the amplitude of the distant seismic signal from a completely contained underground explosion is determined by the permanent displacement produced in the neighborhood of the source. A static-equilibrium theory of this displacement is developed. A Coulomb-Mohr type of yield condition is used to determine the stresses in the near zone where the stresses are beyond the elastic limit. If the internal friction parameter that occurs in the Coulomb-Mohr yield condition is treated as a phenomenological constant, to be determined by the seismic data, it is possible to obtain reasonably good agreement with the relative amplitudes of

the seismic signals observed in the Project Cowboy series of chemical explosions in cavities of various sizes in salt. The indicated value of the friction parameter is, however, appreciably less than the values usually observed in compression tests on unconsolidated materials. The theory is also consistent with the observed size of the cavity produced in tuff by the underground nuclear explosion Rainier, but an even smaller value of the friction parameter must be assumed in this case. (auth)

30971 NATURAL VARIATIONS IN ISOTOPIC ABUNDANCES OF SILICON. David Tilles (Univ. of California, Berkeley). J. Geophys. Research, 66: 3003-13(Sept. 1961).

Measurements of natural variations in isotopic abundance ratios of silicon are reported. A maximum natural range of 5.3 per mil in Si^{30} is observed to date. Coexisting biotite, quartz, and feldspars from some specimens of igneous rock from the Yosemite region differ by as much as 3 per mil; in other grossly similar igneous rocks from the same region the same minerals differ by less than 0.3 per mil. In those rocks with large differences between the minerals, the ratio of $[Si^{30}]/[Si^{28} + Si^{29}]$ increases in the order biotite, quartz, feldspar. All granitic rocks studied are enriched in Si^{30} with respect to meteorites and basic rocks. Measurements on some sediments and biologic samples covered a range of approximately 4 per mil. A group of tektites covered a range of less than 0.7 per mil, with isotopic abundances centrally distributed within the observed normal terrestrial range. The results are interpreted, and applications of such studies to problems of geothermometry and formation of igneous rocks are discussed. (auth)

30972 VARIATIONS OF SILICON ISOTOPE RATIOS IN A ZONED PEGMATITE. David Tilles (Univ. of California, Berkeley). J. Geophys. Research, 66: 3015-20(Sept. 1961).

Isotopic abundance variations of silicon in quartz and feldspar from the Rose Quartz Pegmatite of the Pala district in Southern California are reported. All feldspar samples are enriched in Si^{30} with respect to adjacent quartz samples, and the magnitude of enrichment varies from 0.6 to 2.7 per mil in Si^{30}. Feldspar-quartz differences were found to increase from outer zones towards the inner quartz core. All measurements on quartz samples were within a total range of about 0.6 per mil. The feldspars most heavily enriched in Si^{30} are believed to result from Rayleigh fractionation during crystallization from a vapor phase. (auth)

30973 ON THE GEOCHEMICAL CHARACTER OF IODINE IN METEORITES. Gordon G. Goles and Edward Anders (Univ. of Chicago). J. Geophys. Research, 66: 3075-7(Sept. 1961).

Iodine analysis by neutron activation was used to study the distribution among meteoritic phases. Leaching experiments indicate that most of the iodine in the bronzite and hypersthene chondrites, Richardton and Bruderheim, and at least one third that in the carbonaceous chondrite, Murray, resides in one or more water soluble phases. Experiments on separated phases from iron meteorites indicate that iodine is accommodated more easily in troilite than in metal. It is hypothesized that oldhamite is the iodine host mineral and concluded that iodine is subjected to extensive chemical processing after its incorporation in the parent bodies. (L.N.N.)

30974 URANIUM IN BRITISH SURFACE AND UNDERGROUND WATERS. J. D. Peacock (Atomic Energy Div., Geological Survey of Great Britain, London). Nature, 191: 1189-90(Sept. 16, 1961).

Uranium was determined by both colorimetric and fluorimetric methods. Some underground waters were found to contain higher concentrations of uranium than surface waters. The highest recorded uranium concentration (30 to 50 γ/l) was found in water from a shaft at the disused South Terras uranium mine. Uranium concentration in spa waters was consistent with their origin, composition, and extended contact with crystal rocks. A lack of consistency between analyses undertaken at different times on Cornish mine waters was considered to be due to differing weather conditions. Measurements of the uranium content of waters in Great Britain and abroad indicated that the amount of dissolved uranium reaches a maximum when rain follows a dry spell during which normal weathering processes in the zone of oxidation make available abnormal quantities of uranium in a readily soluble form. (P.C.H.)

30975 BARIUM-140 IN NEW ZEALAND RAINWATER. G. S. McNaughton and R. N. Woodward (Dept. of Scientific and Industrial Research, Lower Hutt, N. Z.). Nature 191: 1344-5(Sept. 30, 1961).

Some of the results of a program started in November, 1958 to determine 28-year strontium-90 and 12.8-day barium-140 in fortnightly accumulated rain samples, are reported. The strontium-90 and barium-140 depositions were calculated from the measured activities of their daughter products, 64-hr yttrium-90 and 40-hr lanthanum-140. The measured counts were never greater than 1 cpm. During early 1959 the accuracy of the barium-140 determinations was about ± 100 μc/sq mile, but was reduced to about 1 to 2 μc/sq mile by 1961. Results for total beta activity suggest that the October series of tests in the Soviet Union did not contribute more than 4% of the total strontium-90 deposited at Lower Hutt from November, 1958 until June, 1959. During 1960-61 six positive barium-140 results were obtained after the French test on February 13, 1960, and also approximately four weeks after each of the French tests on April 1, and December 23, 1960. The data are tabulated. (P.C.H.)

30976 ON THE DISTRIBUTION OF ATOMS OF RADIOACTIVE ELEMENTS IN MINERALS. I. E. Starik, K. F. Lazarev, and E. P. Petryaev. Radiokhimiya, 3: 207-14 (1961). (In Russian)

Distribution of radioelements in monazites, analyzed by leaching, is irregular and is characterized by enriched lattices and capillary surfaces with atoms both daughter and mother elements. Atoms of radium isotopes are found in monazites in two forms with different capacities for exchange in leach solutions. (R.V.J.)

30977 FALLOUT FROM 1957 AND 1958 NUCLEAR TEST SERIES. New York City Data Show Contributions from Short-Lived Nuclides for as Long as 14 Months After Testing. William R. Collins, Jr., George A. Welford, and Robert S. Morse (U. S. Atomic Energy Commission, New York). Science, 134: 980-4(Oct. 6, 1961).

The causes and effects of high concentrations of shorter-lived fission products in fall-out in New York City during 1958 and 1959 are discussed. Data previously reported are supplemented with data on concentrations of Sr^{90}, Cs^{137}, Ru^{106}, Ce^{144}, Sr^{89}, Zr^{95}, and W^{185} measured in monthly fall-out collections during 1959. Examination shows that the shorter-lived fission products predominated over Sr^{90} and Cs^{137} from the beginning of 1958 through the middle of 1959. Through analysis of isotope ratios, W^{185} concentrations, and monthly rainfall volumes, it was established that more fall-out arrived in New York City from the Soviet series in October 1958 than from earlier series, and that the Soviet debris was richer in short-lived nuclides because it was deposited sooner after its production. Methods, age and origin of debris, air activity concentrations, and gamma

dose are all discussed. The calculated contributions of the fall-out that accumulated on the ground in New York City during 1958 and 1959 to external gamma radiation dose rates and to long term doses are both illustrated and tabulated. (P.C.H.)

30978 ADSORPTION OF RADIOSTRONTIUM BY SOME SOILS AND SOIL MATERIALS. V. I. Spitsyn and V. V. Gromov. Soviet Soil Sci. (English Translation), No. 12: 1410-14(Dec. 1959).

Adsorption of the radioactive fission product strontium was studied with 50 natural materials frequently found in soils, from solutions containing no extraneous cations and in the presence of stable strontium or calcium ions. The greatest adsorption of radiostrontium was shown by the clay minerals (montmorillonite, kaolinite, halloysite) micas, hydrous micas, peat, pyrolusite, phosphorite, and nepheline syenite. Therefore, when radiostrontium falls on soils, one expects highest contents where these minerals are present, other things being equal. It was established that the ability of natural materials to adsorb radiostrontium strongly depends on a large exchange capacity. The presence of calcium, even as little as 100 mg/l, considerably reduces the adsorption of microquantities of strontium from solution. (Public Health Eng. Abstr., 46: No. 8, 1961).

30979 VOPROSY YADERNOI METEOROLOGII. (Questions of Nuclear Meteorology). B. I. Styra. C. Garbaliauskas, ed. Vilnius, Lithuania, Institute of Geology and Geography, Academy of Sciences of the Lithuanian SSR, 1959. 418p.

A systematic exposition is given of questions connected with the study of atmospheric radioactivity. Attention is centered on the processes of natural atmospheric radioactivity, however, the questions connected with artificial contamination are also discussed. Radioactivity is discussed in such terms as weather effects, penetration and formation, variations, and theory. (N.W.R.)

30980 THE ABUNDANCE OF THE ELEMENTS. Lawrence H. Aller. Interscience Monographs and Texts in Physics and Astronomy. Volume VII. New York, Interscience Publishers, Inc., 1961. 290p.

An assessment is given of the abundances of the elements in the earth's crust, meteorites, the sun, stars, and gaseous nebulae. A short summary is presented on the theories of elemental building in stars. (N.W.R.)

30981 ABUNDANCE OF CHEMICAL ELEMENTS. V. V. Cherdyntsev. Translated by Walter Nichiporuk. Chicago, University of Chicago Press, 1961. 309p.

An outline of the current status of the science of the abundance of chemical elements, the nuclear processes associated with the change in the chemical composition of the cosmos, and the foundations for a theoretical description of the problem is given. A summary of the fundamental material on the abundance of chemical elements in different sectors of the cosmos is given with special attention toward nuclear reactions which alter the composition of matter, such as radioactive decay and the artificial transmutation of atomic nuclei. The elementary theory of stability of atomic nuclei is stated on the basis of some simpler models. The basic regularities in the abundance of isotopes is also discussed. A review of works on the abundance theory is given, and a theory of the formation of atomic nuclei under conditions of dissociation equilibrium in a neutron environment, which most satisfactorily describes observed regularities is presented. 303 references are given to U. S. and foreign books and journals published from 1908 to 1959, and author and subject indexes are included. (P.C.H.)

HEALTH AND SAFETY

30982 (A/AC.82/G/L.590) CONTAMINACION POR RADIOESTRONCIO DURANTE EL ANO 1960. Informe No. 50. (Radiostrontium Contamination During the Year 1960. Report No. 50). D. Beninson, J. Kramer, E. Mariano, and E. Ramos (Argentina. Comision Nacional de Energia Atomica, Buenos Aires). 1961. 12p.

The annual deposition of Sr^{90} measured in the Buenos Aires region during 1960 was 0.8 mc/km^2, and the concentration in the air was 0.2×10^{-3} $\mu\mu$c/kg, which is lower than the corresponding data for the previous year. The studies clearly indicated that during rainy seasons in spring and autumn the deposition of Sr^{90} increases. The levels of Sr^{90} in milk in the northern hemisphere are considerably lower (2 $\mu\mu$c/g Ca). Contamination of plants and subsequently of milk indicates the route of fall-out. The mean level of Sr^{90} in the bones of children was 0.7 $\mu\mu$c/g Ca with low dispersion. (R.V.J.)

30983 (A/AC.82/G/L.605) RELATIONSHIP BETWEEN THE DEPOSITION OF STRONTIUM 90 AND THE CONTAMINATION OF MILK IN BRITAIN DURING 1958-1960. B. O. Bartlett, J. D. Burton, and R. Scott Russell (Gt. Brit. Agricultural Research Council. Radiobiological Lab., Grove, Berks, England). July 1961. 15p.

Alternative methods were used to estimate the relative extents to which the Sr^{90} in milk produced in England and Wales was determined by the annual deposition of fall-out and the cumulative total in the soil during the years 1958 to 1960. Proportionality factors are suggested for estimating Sr^{90} from measurements of the current deposit and the cumulative total estimated from the analysis of rain water. Assumptions were used which are considered to indicate the possible upper limit of the contribution of the soil. The calculations should therefore be a cautious basis for the prediction of future situations. It is emphasized, however, that only very approximate relationships can be established. In 1958 and 1959 the level of Sr^{90} in milk was determined mainly by the direct retention of the recent deposit on vegetation, but in 1960, when the rate of fall-out had decreased, absorption from the soil may have been responsible for about four-fifths of the contamination in milk. The more thorough incorporation in the soil causes a progressive decrease in its contribution to the contamination of diet. It is emphasized that calculations made for one region are not necessarily applicable to others and that the importance of absorption from the soil will be enhanced in areas where the Ca content of the soil is particularly low. (auth)

30984 (A/AC.82/G/L.606) THE GENETICALLY SIGNIFICANT DOSE IN MEDICAL USES OF X-RAYS AND RADIOACTIVE MATERIALS. H. Holthusen, H.-K. Leetz, and W. Leppin (Germany. Bundesministerium für Atomkernenergie und Wasserwirtschaft). Mar. 3, 1961. 11p.

A survey was made during 1957 and 1958 of the radiation dose to the population of Hamburg due to diagnostic radiology and radiotherapy of non-malignant conditions. Data are tabulated. The genetic significance of the doses is discussed. (C.H.)

30985 (AD-259719) A NUCLEAR REACTOR FACILITY SAFETY INSPECTION GUIDE (thesis). Leon Ellington McKinney (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio). Feb. 1961. 96p. (GNE/Phys/61-13)

A detailed safety inspection guide for use by the Air Force in inspecting its nuclear reactor facilities is proposed. The philosophy of inspection is discussed, both in general terms and in specifics dealing with reactor facilities. The conduct of an inspection is discussed, along with the importance of the human element in nuclear reactor safety. Inspection procedures currently in use by the AEC are explained as well as self-inspection programs employed by contractors. The present Air Force organizational structure for its safety inspection program and the various inspections of a reactor facility through its first year of operation are discussed in detail. Then, proposed procedures with which the Air Force could effect its facility inspection program are outlined. (auth)

30986 (APAE-79(Suppl.I)) HAZARDS EVALUATION OF THE SM-1 PENETRATED GASKET. J. R. Coombe, F. G. Gebhardt, and B. James (Alco Products, Inc., Schenectady, N. Y.). Sept. 8, 1961. Contract AT(30-1)-2639. 24p.

The as-constructed SM-1 penetrated gasket designed for the SM-1 core and flow instrumentation is described. The effects of a postulated failure of this gasket were evaluated. The effects of failure on the maximum credible accident were determined and conclusions and recommendations for the use of this gasket are made. (auth)

30987 (APAE-84(Add.II)) HAZARDS REPORT FOR INSERTION OF THE PM-1-M-2 ELEMENT IN THE SM-1 CORE II. J. R. Coombe and J. F. Scoles, eds. (Alco Products, Inc., Schenectady, N. Y.). Sept. 1, 1961. Contract AT(30-1)-2639. 57p.

The PM-1-M-2 test element is described. The potential hazard incurred by its inclusion in the SM-1 Core II was analyzed. A nuclear analysis developed power distributions and reactivity effects. Hydraulic and thermal analyses developed anticipated burnout heat flux ratios. An evaluation of the risk involved with the inclusion of this element is presented. (auth)

30988 (BIO/03/61) DATA ON ENVIRONMENTAL RADIOACTIVITY, COLLECTED IN ITALY (JULY-DECEMBER 1960). (Italy. Comitato Nazionale per l'Energia Nucleare, Rome). Feb. 1961. 149p. (A/AC.82/G/L.594).

Data collected from July to December 1960 in Italy on the beta radioactivity of fission products in air at ground level, beta radioactivity of fission products in fall-out, beta radioactivity in geographical waters and drinking water, and Sr^{90} and Cs^{137} determinations in various materials are presented. (M.C.G.)

30989 (FFIF-IR-F-417) CESIUM-137 AND STRONTIUM-90 IN PRECIPITATION, SOIL AND ANIMALS IN NORWAY. T. Hvinden and A. Lillegraven (Norway. Forsvarets Forskningsinstitutt, Lillestrøm). Aug. 1961. 10p.

Results are given of measured concentrations of cesium-137 and strontium-90 in rain water, soil, and animal meat in Norway. It seems that, for interval radiation from fallout materials, the variations in uptake of radioisotopes by animals may be more important than the uneven geographical distribution of fallout. (auth)

30990 (FFIS-IR-S-06) FALLOUT IN NORWEGIAN MILK IN 1960. A. Lillegraven, L. Lund, and O. Michelsen (Norway. Forsvarets Forskningsinstitutt, Lillestrøm). May 18, 1961. 21p.

The strontium-90 and cesium-137 contents in Norwegian milk were measured regularly in samples from 11 climatically and topographically different localities during 1960.

The results of the measurements are given graphically and in tables. (auth)

30991 (HASL-115) FALLOUT PROGRAM. Quarterly Summary Report [for] June 1, 1961–September 1, 1961. Edward P. Hardy, Jr., Joseph Rivera, and Robert Frankel (New York Operations Office. Health and Safety Lab., AEC). Oct. 1, 1961. 405p.

Current data are presented from the HASL Fallout Program, the High Altitude Sampling Program, the U. S. Naval Research Laboratory, and the Canadian Department of National Health and Welfare. Radionuclide levels in deposited fallout, air, water, and milk are given in tabular form. Interpretive reports and notes dealing with atmospheric and fallout radioactivity levels, Sr^{90} in U. S. diets, tap water, grains, and miscellaneous samples of biological interest, are included. Also presented are results of a seven year survey of Sr^{90} levels in soil, herbage, and animal bone at selected pasture sites in the United States, and a summary of the Sr^{90} quality control program carried out at one of the AEC's contractor laboratories. A bibliography of recent literature pertinent to fallout studies is given. (auth)

30992 (HW-68645) PLUTONIUM INHALATION STUDIES. III. EFFECT OF PARTICLE SIZE AND TOTAL DOSE ON RETENTION AND TRANSLOCATION. W. J. Bair and D. H. Willard (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 1961. Contract AT(45-1)-1350. 48p.

Forty-eight beagle dogs were exposed to plutonium dioxide aerosols of three particle size distributions. The aerosol concentrations varied from 0.1 to 1000 picocuries per cc air and the total plutonium deposited varied from 0.01 to 100 μc. For a given amount of plutonium deposited the percentage apparently deposited in the alveoli and retained for gradual clearance was greatest for plutonium inhaled as particles with a mass median diameter of 4.3 μ, less for 3.3 μ, and even less for 0.65 μ particles. The rate of clearance, translocation, and excretion in urine and feces was greatest for plutonium inhaled as particles with a mass median diameter of 0.65 μ. Possible explanations for the results are discussed and the importance of the results to health physics practices is indicated. (auth)

30993 (HW-70411) EVALUATION OF RADIOLOGICAL CONDITIONS IN THE VICINITY OF HANFORD, JANUARY–MARCH 1961. I. C. Nelson, ed. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 1, 1961. Contract AT(45-1)-1350. 24p.

An evaluation of radiological conditions in the vicinity of Hanford for the first quarter of 1961 indicates only minor changes in environmental exposures as compared with 1960. The principal Hanford source of exposure continues to be identified with radionuclides in reactor cooling water discharged to the Columbia River. (P.C.H.)

30994 (HW-70552) EVALUATION OF RADIOLOGICAL CONDITIONS IN THE VICINITY OF HANFORD, APRIL–JUNE 1961. I. C. Nelson, ed. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 15, 1961. Contract AT(45-1)-1350. 25p.

An evaluation of radiological conditions in the vicinity of Hanford for the second quarter of 1961 indicates only minor changes in environmental exposures as compares with 1960 and the first quarter of 1961. The principal Hanford source of exposure continues to be identified with radionuclides in reactor cooling water discharged to the Columbia River. For individuals whose habits regularly include drinking Pasco sanitary water, ingesting of local fish and waterfowl, and consuming produce from local farms, an intake of bone-seeking radionuclides is estimated at about 40% of that recommended by the National Committee on Radiation Protection and Measurements (NRCP) as maximum for continuous intake by persons in the neighborhood of controlled areas. The dose to the GI tract from drinking Pasco sanitary water for the 12 months ending with June of 1961 is calculated as about 90 mrems, which amounts to 6% of the recommended maximum permissible limit. (auth)

30995 (IDO-28506) ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM. GCRE-I HAZARD SUMMARY REPORT. (Aerojet-General Nucleonics, San Ramon, Calif.). Dec. 1958. Decl. July 8, 1959. Contract AT(10-1)-880. 269p.

The Gas-Cooled Reactor Experiment-I is described with particular emphasis on the neutronic characteristics, the control and instrumentation systems, and plant safety considerations. The plan of operation is discussed and significant operating procedures are included. The site is described with reference to geology, climate, and population density. Hazards which could result from both normal and abnormal operation were analyzed with emphasis given to possible excursions and to the distribution of any resultant radioactive products. It was concluded that a condition which would be hazardous to the surrounding area could result only from gross physical changes in the reactor core. It was further developed that such a change could result only from the concurrent failure of the control system and the catastrophic failure of the pressure vessel. These failures could be promoted by extremely unlikely occurrences such as sabotage, bombing of the facility, or the dropping of a large object into the pool. No individual operating error or equipment malfunction could result in the maximum credible accident as defined by this report. (auth)

30996 (IDO-28506(Add.)) GCRE-I HAZARD SUMMARY REPORT. (Aerojet-General Nucleonics, San Ramon, Calif.). Mar. 1959. Decl. July 8, 1959. Contract [AT(10-1)-880]. 12p.

The GCRE-I hazard summary report is supplemented in the following areas: geometry and operation of the steam cooling system, the reactor coolant by-pass, and by-pass valving; the means by which by-passed circuits are prevented from remaining unintentionally disabled; design details, and details of procedure for core flooding operations. (A.C.)

30997 (IDO-28506(Add.II)) ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM. GAS-COOLED REACTOR EXPERIMENT-I HAZARDS SUMMARY REPORT, ADDENDUM II. (Aerojet-General Nucleonics, San Ramon, Calif.). [nd]. Contract [AT(10-1)-880]. 56p.

A hazards evaluation was made to determine the effects of two basic changes to the mode of operation of the GCRE-I. These changes are: the substitution of a pressure tube bundle fabricated from stainless steel for the existing aluminum bundle; and the substitution of pin-type fuel elements for plate-type elements. It was concluded that in four of the six probable combinations of the old and new fuel elements with the old and new pressure tube bundles, the severity of the maximum credible accident is less than that of the maximum credible accident previously evaluated. (M.C.G.)

30998 (IDO-28506(Add.III)) ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM. GCRE-I HAZARDS SUMMARY REPORT. ADDENDUM III. (Aerojet-General Nucleonics, San Ramon, Calif.). May 1960. Contract [AT(10-1)-880]. 4p.

The hazards evaluation was modified to reflect certain

changes made to the equipment as a result of operating experience. These changes included: the addition of a start-up interlock circuit; the modification of a startup interlock circuit; several minor modifications to the control rod actuators; and the addition of the tube-sheet cooling system. (M.C.G.)

30999 (KAPL-M-HP-9) HEALTH PHYSICS QUARTERLY REPORT, APRIL–JUNE 1961. R. J. Feinberg, comp. (Knolls Atomic Power Lab., Schenectady, N. Y.). Contract W-31-109-eng-52. 31p.

The quarterly audit of external and internal radiation exposure at KAPL revealed no exposure greater than the applicable standards of the Federal Radiation Council, the USAEC, and the NCRP. Radioactivity levels in the Knolls environment indicated that KAPL operations did not contribute adversely to the background radioactivity during the period. Routine radiation services during the period are summarized. (C.H.)

31000 (NP-9934) SKAZENIA RADIOAKTYWNE POWIETRZAIWODY W POLSCE W 1959 ROKU. (Radioactive Contamination of the Atmosphere in Poland in 1959). (Poland. Panstwowa Rada do Spraw Pokojowego Wykorzystania Energii Jadrowej, Warsaw). 1960. 139p.

Ten papers on fall-out in the atmosphere, surface waters, and milk and bones in Poland, 1959, are given. Separate abstracts were prepared for each. (T.R.H.)

31001 RADIOACTIVE CONTAMINATION OF AIR AND ATMOSPHERIC FALLOUT IN SOPOC, OF SALT WATER IN THE SOUTH BALTIC, DANISH STRAITS, AND NORTH AND EAST ATLANTIC IN 1959. I. Adamczewski (School of Tech., State Academy of Sciences, Danzig), J. Dera, B. Łokuciejewski, and B. Szczeblewski. p.1-18 of "Skazenia Radioaktywne Powietrzaiwody w Polsce w 1959 Roku." Warsaw, State Commission on Peaceful Applications of Atomic Energy, 1960. (In Polish).

Fallout particles and atmospheric precipitation were collected at Sopoc, Poland by means of a funnel lined with a clear lacquer that was connected to the neck of a plastic container. The tapped liquid was slightly acidified, evaporated with a filter paper placed therein, and the activity of the residue of burnt filter paper was measured between 2 thin-window GM counters. Radioactive dust in the air was caught by a filter through which the air was pumped. The percentage removal of aerosol particles versus rate of air flow through the filter were determined by the method of W. Zumacha, so that the proper correction to total radioactivity in air could be made. These filters were also burned and counted. The samples of sea water were filtered, and fission products removed along the lines of the method of J. Kooi, A/Conf. 15/P/549-1958, with the major exception of adding a Sr carrier to precipitate much more of the Sr^{90}. The standard deviation of the measurements did not exceed 3.3%. Atmospheric contamination is presented for each day of the year. The sea water activity in the vicinity of the Baltic Sea varied with the time of year, the flow of water to and from the Atlantic, and weather conditions. The results of these investigations are presented in 15 pages of tables and graphs. (TTT)

31002 RADIOACTIVE CONTAMINATION OF THE ATMOSPHERE IN LODZ IN 1959 FROM NUCLEAR EXPLOSIONS. H. Hofmokl, B. Bończak, T. Frey-Swiniarska, and I. Zukowska (Univ. of Lodz, Poland). p.19-33 of "Skazenia Radioaktywne Powietrazaiwody w Polsce w 1959 Roku." Warsaw State Commission on Peaceful Applications of Atomic Energy, 1960. (In Polish).

Each day, 1 liter of distilled water was placed in a 2000-cm^2 pan of water that was situated atop a building for 24 hours. The mixture of distilled water, fallout particles and possibly rain water was distilled off a filter paper, the paper burned and the ash counted with a type BAT-25 counter that had a 25 mm window of 2 mg/cm^2 mica. The counter was calibrated with a standard KCl source. The standard diviation of the measurements was 3%. Thirteen pages of tables and graphs are presented. Comparing with 1958 results, one observes a general decrease of contamination, with the highest daily average of 1.135 mc/km^2/day in February and the lowest of 0.055 mc/km^2/day in December. The latter figure is only 2.5% of the activity of December 1958. This can be explained by nuclear explosions in U.S.A. and U.S.S.R. during the period of October 15-22. The contamination is carried in dust clouds and "washed" out by rain. After a period of about 8 months, a small fraction of the earlier peak values of fallout is observed in Lodz, Poland. (TTT)

31003 RADIOACTIVE CONTAMINATION OF THE ATMOSPHERE IN KRAKOW IN 1959 BROUGHT ABOUT BY NUCLEAR EXPLOSIONS. L. Jurkiewicz and M. Massalska (Inst. of Nuclear Research, State Academy of Sciences, Krakow and Academy of Mining and Metallurgy, Krakow). p.33-50 of "Skazenia Radioaktywne Powietrzaiwody w Polsce w 1959 Roku." Warsaw, State Commission on Peaceful Applications of Atomic Energy, 1960. (In Polish).

This work is a continuation of the monitoring of complete fallout, from rain and dust particles, that had been under way in 1957 and 1958. As in the past, the data have been applied to the determination of the date of a nuclear explosion. The fallout of January, 1959, using the model of Way and Wigner, gives an exponent of 1.2 and fixes the time of the explosion to the period Oct. 19, 1958 to Nov. 7, 1958. The fallout of February through June gives an exponent of 1.2 to 1.5. After July, the fallout becomes quite small and hardly useful for dating the explosions. Sixteen pages of tables and graphs present the 1959 data. (TTT)

31004 MEASUREMENTS OF THE RADIOACTIVE CONTAMINATION OF RIVER WATER AND TAP WATER OF KRAKOW. L. Jurkiewicz and M. Massalska (Inst. of Nuclear Research, State Academy of Sciences, Krakow and Academy of Mining and Metallurgy, Krakow). p.51-5 of "Skazenia Radioaktywne Powietrzaiwody w Polsce w 1959 Roku." Warsaw, State Commission on Peaceful Application of Atomic Energy, 1960. (In Polish).

In connection with plans for wide application of reactor technology and use of radioisotopes in industry, medicine and agronomy in Poland, the measurement of radioactive contamination of water was begun in February, 1958. The methods of measurement are similar to those given earlier. A potassium standard was used for calibration. The mass of residue of a 1-liter sample and the specific activity in picocuries per liter is given for four sources of water throughout the year 1959. No relationship between mass of residue and radioactivity is evident. During the autumn of 1959, the dry months, the contamination falls off. This is ascribed to a decrease in the amount of leaching of radioactive contaminants in the soil. The mean activity of the water passing through the city is about equal to that of water entering the city at the outskirts. (TTT)

31005 RADIOACTIVITY MEASUREMENTS IN 1959 OF DUST PARTICLES IN AIR, OF ATMOSPHERIC FALLOUT, RIVER WATER ENTERING THE SEA AND SEA WATER–HYDROLOGICAL-METEOROLOGICAL INSTITUTE. T. Kopcewicz, R. Tomaszenko, J. Tomczak, J. Tokarczyk, and J. Orlicz. p.56-79 of "Skazenia Radioaktywne

Powietrzaiwody w Polsce w 1959 Roku." Warsaw, State Commission on Peaceful Applications of Atomic Energy, 1960. (In Polish).

The radioactive contamination of dust particles in air, of fallout particles, of rain water, of water at the mouth of the Swibno River and of the Baltic Sea were measured at three stations of the State Hydrological-Meteorological Institute in Poland: I. The Aerological Division at Legionowo, II. The Oceanographic Division at Gdynia, III. The High Altitude Meteorological observatory at Kasper Peak. Rain water contamination was measured at locations I, II, and III; dust particles (aerosol) contamination at I and II; fallout at I and III; river water and sea water at II. The twenty-two pages of tables and graphs present the data, most of which covers all of 1959. Several of the measurements were initiated in July of 1959. The data show a comparatively small amount of rain water and atmospheric contamination after July of 1959. However, the river water and sea water contamination are seen to be much more constant. Both waters tend to follow the time variation of air contamination, with sea water displaying the smallest degree of correlation. The general methods of measurement have been published in Acta Geophysica Polonica 7 (1959), No. 2 and in the Information Bulletin of the State Commission on Peaceful Application of Atomic Energy (1959), No. 9. (TTT)

31006 GENERAL BETA RADIOACTIVITY IN WATERS OF POLAND IN 1959. R. Szepke, M. Bysiek, and D. Grzybowska (Central Lab. for Radiological Protection, Poland). p.99-111 of "Skazenia Radioaktywne Powietrzaiwody w Polsce w 1959 Roku." Warsaw, State Commission on Peaceful Applications of Atomic Energy, 1960. (In Polish).

The systematic measurement of general beta activity in Polish waters was undertaken by the Central Laboratory of Radiological Protection (CLOR) beginning in November, 1958. This article is based on a CLOR report, number CLOR-2, Warsaw, 1960, and only covers the work carried out in 1959. The water was sampled at 18 points, including 6 rivers, 1 canal, 3 well-water points, 1 lake and 1 reservoir. Twenty-four salt-water samples were taken in the seas of Europe and in the East Atlantic. One liter samples of fresh water were mostly obtained 20 cm below water level. These were slowly evaporated, the residue collected on a damp, ash-free filter paper, the paper burned and the residue counted, in batches no larger than 250 mg, 72 hours from the time the water sample was collected. The counter was a type BAT-25 GM counter which was calibrated with K_2CO_3 whose natural specific activity is 430 pC/gm. The average potassium content in running water, for 30 samples, was 7 ppm, producing an activity of 5.2 pC/1. Three samples of tap water yielded a potassium contribution of 4.3 pC/1. The salt water was obtained in 0.5-liter quantities, slowly evaporated in 100-ml lots, the residue weighed on a torsion balance, and had its beta activity measured with a BAT-25 GM counter. (TTT)

31007 SOME COMMENTS ON PROCEDURES OF RESEARCH AND MEASUREMENT OF RADIOACTIVE CONTAMINATION OF THE ATMOSPHERE BY THE METHOD OF AEROSOL FILTRATION. J. Wesołowski, B. Jackowski, D. Tokar, B. Tokar, and A. Wasiewicz (Normal School, Opole, Poland). p.112-23 of "Skazenia Radioaktywne Powietrzaiwody w Polsce w 1959 Roku." Warsaw, State Commission on Peaceful Applications of Atomic Energy, 1960. (In Polish).

Radioactive measurements are presented for the year 1959 in eleven pages of graphs and charts for the water from three rivers and one reservoir in Poland and for the aerosol particles and rain water at Opol, Poland. All measurement procedures were carried out without change from those of 1958 except for the aerosol filtration measurements. The dust particle filtration was accomplished by pumping air, with an oil rotary pump, through a double layer of quantitative filter paper of 14-cm diameter at the rate of $9m^3$/hour. The filter paper is crumpled into a covered container of porcelain and burned in a furnace for 2 to 5 hours at a temperature of about 720°C. After weighing the ash on an analytical balance, it is placed at the window of a type BAT-25 GM counter, inside a 5-cm-thick lead shield. The calibration of the counter arrangement is the same as for the 1958 measurements. (TTT)

31008 RADIOACTIVE CONTAMINATION IN 1959 OF ATMOSPHERIC FALLOUT, OF WATER IN THE SWIDER RIVER AND OF DRAINAGE WATER FROM THE TERRAIN WITHIN I.B.J. OF SWIERK. K. Zarnowiecki, and A. Kostyrko (Inst. of Nuclear Research, Polish Academy of Sciences, Krakow). p.124-35 of "Skazenia Radioaktywne Powietrzaiwody w Polsce w 1959 Roku." Warsaw, State Commission on Peaceful Applications of Atomic Energy, 1960. (In Polish)

At the Institute of Nuclear Research (I.B.J.) in Swierk, radioactive contamination measurements were carried out for total atmospheric fallout, for water of the Swider River 8 km upstream, 8 km downstream and at a point nearest the reactor, for reservoir water of Swierk and for deep well water near the I.B.J. physics building and near the reactor. The fallout, with rainwater, is collected in a $0.5m^2$ area. One-liter standard samples of water are evaporated to 50 ml to which is added 100 mg of Na_2SO_4 as a carrier. This solution is placed in a pre-weighed quartz container and is then dried and weighed again. The residue is removed and weighed. A few-percent loss of solids sticking to the quartz evaporator is typical. The solids are now glued between 2 pieces of paper, 1 to $3mg/cm^2$, and their radioactivity measured between 2 GM counters, type BAT-25. The twin GM counter arrangement is about 50% efficient, as determined by calibration with 150 mg KCl. Day-to-day calibration is accomplished with a $Sr^{90}-Y^{90}$ preparation. Good stability is reported. (TTT)

31009 MEASUREMENTS IN 1959 OF SR-90 CONTENT IN BONES OF HUMANS AND ANIMALS, AND IN MILK AS DETERMINED BY THE DIVISION OF RADIOLOGICAL PROTECTION OF THE INSTITUTE OF MEDICAL PRACTICES IN LODZ. J. Liniecki, W. Czosnowska, and W. Karniewicz. p.136-8 of "Skazenia Radioaktywne Powietrzaiwody w Polsce w 1959 Roku." Warsaw, State Commission on Peaceful Applications of Atomic Energy, 1960. (In Polish)

The long bones of beef and veal were obtained from the states of Lublin, Warsaw, Gdansk, Bydgoszcz, Katowice and Krakow. Powdered milk was obtained from the 5 production centers of Poland. Other milk samples were obtained from the highland regions in the vicinity of the Clinic of Childhood Diseases in Krakow. The bones of humans were furnished by the Division of Pathological Anatomy in Lodz and the Clinics of Childhood Diseases in Lodz and Krakow. Both milk and cattle bones from the highlands had the greater Sr-90 content. The Sr-90 from humans below the age of 20 was almost twice that of the above-20 grouping. (TTT)

31010 (NP-10729) MEDICAL ASPECTS OF RADIOLOGICAL HEALTH. COURSE MANUAL. (Robert A. Taft Sanitary Engineering Center, Cincinnati). Dec. 1960. 439p.

The text for a course designed for public health medical,

dental, and biological personnel is presented. The biological effects of radiation, practical methods for reducing exposures, and radiological health program planning are emphasized. (J.R.D.)

31011 (NP-10733) RADIOACTIVE POLLUTANTS IN AIR. COURSE MANUAL. (Robert A. Taft Sanitary Engineering Center, Cincinnati). Feb. 1961. 337p.

The text for a professional level course concerned with air contamination is presented. Particular emphasis is directed toward techniques for sampling and analysis, and data interpretation. (J.R.D.)

31012 (NP-10789) RADIOLOGICAL DECONTAMINATION METHODS AND EQUIPMENT FOR COLD-WEATHER REGIONS. Technical Report No. 105. D. Taylor, E. N. Hellberg, W. R. Nehlsen, and L. K. Donovan (Naval Civil Engineering Lab., Port Hueneme, Calif.). Sept. 27, 1961. 89p.

Information designed to be used along with NAVDOCKS TP-PL-13, Radiological Recovery of Fixed Military Installations, in order to adapt TP-PL-13 to cold-weather conditions is presented. The effects of cold weather upon the operation of the basic recovery plan are pointed out; the major problem areas most likely to be encountered in recovering a fixed military installation subjected to radiological contamination in cold climatic conditions are outlined, and methods and equipment to be used for radiological decontamination are indicated and illustrated for various cold-weather conditions. The judgments are based in large part on appended reports of tests in Alaska, which were designed to fill in gaps where further experimental work was needed to augment existing decontamination information. (auth)

31013 (NP-10790) INTERNAL DOSES FROM MIXED FISSION PRODUCTS. U. Greitz and K. Edvarson (Sweden. Försvarets Forskningsanstalt, Stockholm). Dec. 1960. 80p.

Internal doses from ingestion of fission products with an admixture of neptunium-239 were calculated for different ingestion periods. It is found that thyroid is the organ receiving the highest dose during the first 15 to 30 days. (auth)

31014 (NP-10791) INTERNAL DOSES FROM FISSION PRODUCTS IN MILK. U. Greitz and K. Edvarson (Sweden. Försvarets Forskningsanstalt, Stockholm). June 1961. 16p.

Internal doses to man from fission product nuclides occurring in milk from cows grazing on contaminated areas were calculated for different ingestion periods. It was found that the thyroid dose will dominate during the first months after fission, and after that time bone. (auth)

31015 (NYO-4813) AIR CLEANING STUDIES. Progress Report, July 1, 1958—June 30, 1959. Richard Dennis, Leslie Silverman, Edward Kristal, Yoichi Takashima, Frederick L. Muller, Joseph J. Fitzgerald, Felix Stein, and Philip Drinker (Harvard Univ., Boston. School of Public Health). Aug. 1, 1961. Contract AT(30-1)-841. 57p.

Progress on the air and gas cleaning project during the period July 1, 1958 to June 30, 1959 is reviewed. Major project objectives included: research and development on air and gas cleaning devices and methods for their testing and evaluation, training and education of Commission and contractor personnel, collection and correlation of information on air and gas cleaning techniques, and consultation services. Performance tests were continued on the 500 CFM Mikro-Pulsaire bag collector and testing were initiated on a small, 70 CFM, model of the same device. Rating of a commercial water-jet scrubber for special application in the processing of liquid wastes was undertaken during the current period. Special research projects continued or initiated include the following: design of incineration and gas cleaning equipment for disposal of low-level radioactive waste, investigation of methods of collection for radioactive iodine, filtration studies on several types of synthetic fiber media, and collection and collation of gas cleaner performance and cost data from several AEC and contractor sites. (auth)

31016 (ORNL-3181) ECOLOGICAL SAMPLING AND METEOROLOGICAL CALCULATION OF FALLOUT ON FORESTS NEAR OAK RIDGE. Jerry S. Olson (Oak Ridge National Lab., Tenn.). Sept. 20, 1961. Contract W-7405-eng-26. 62p.

Spatial patterns of radioactive contamination on forest foliage were measured by gamma spectrometry and are discussed with respect to local vs. world-wide origin of the fallout and implications for ecology, health physics, and management of nuclear facilities. In September 1959, I^{131} on dogwood leaf samples varied from over 500 $\mu\mu c/g$ dry wt near Oak Ridge National Laboratory stacks to 1 to 7 $\mu\mu c/g$ near the margins of the Oak Ridge Reservation. Stack fallout tended to occur closer to the source than was calculated from hourly wind data by an IBM 610 computer program based on Culkowski's adaptation of the Sutton-Chamberlain theory of atmospheric diffusion and deposition. Over most of the Reservation, levels of Ru^{106}, Cs^{137}, Zr^{95}–Nb^{95} and Ce^{144} were similar to levels found elsewhere (2 to 9, 1 to 3, 2 to 9, and 10 to 20 $\mu c/g$ respectively) and were presumably controlled by weapons fallout. Higher levels were found in small areas and indicate the need for attention to localized contamination, even though indirect estimates of concentration per unit area did not yet approach levels considered hazardous from the standpoint of health physics. (auth)

31017 (PNROO-DEV-106) ENVIRONMENTAL RADIOACTIVITY AT THE SHIPPINGPORT ATOMIC POWER STATION FOR THE THIRD QUARTER OF 1960. (Pittsburgh Naval Reactors Operations Office, AEC). Dec. 1, 1960. For Pennsylvania Dept. of Health. 9p.

During the third quarter of 1960, measurements of radioactivity were made in the Ohio River, atmosphere, soil, and fall-out in the vicinity of the Shippingport Atomic Power Station. The results of these measurements confirmed the knowledge that the plant did not contribute significant quantities of radioactivity to the environment as determined by plant effluent monitoring and strict plant control. (auth)

31018 (PNROO-DEV-108) ENVIRONMENTAL RADIOACTIVITY AT THE BETTIS ATOMIC POWER LABORATORY FOR THE FOURTH QUARTER OF 1960. (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Feb. 15, 1961. For Pennsylvania Dept. of Health. Contract AT-11-1-GEN-14. 10p.

Data on the levels of radioactivity measured in the laboratory environs are presented. Measurement results indicate no significant contribution by laboratory operations to the environmental radioactivity levels. Data on radioactivity in liquid effluent, fallout, and soil are included along with area maps. (J.R.D.)

31019 (PNROO-DEV-109) SUMMARY OF ENVIRONMENTAL RADIOACTIVITY AT THE BETTIS ATOMIC POWER LABORATORY FOR CALENDAR YEAR 1960. (Pittsburgh Naval Reactors Operations Office, AEC). Feb. 17, 1961. For Pennsylvania Dept. of Health. 9p.

Measurements of radioactivity in the fall-out and the soil, as well as measurements of background radiation in-

tensities at the boundaries of the Laboratory throughout 1960, show no evidence that Laboratory processes contributed significant amounts of radioactivity to surrounding areas. Radioactivity released to the Laboratory liquid effluent, including fall-out, 1.7×10^{-7} μc/cc, was considerably below the permissible concentration for drinking water. (P.C.H.)

31020 (PNROO-DEV-110) ENVIRONMENTAL RADIOACTIVITY AT THE SHIPPINGPORT ATOMIC POWER STATION FOR THE FOURTH QUARTER OF 1960. (Pittsburgh Naval Reactors Operations Office, AEC). Mar. 1, 1961. For Pennsylvania Dept. of Health. 9p.

31021 (PNROO-DEV-111) SUMMARY OF ENVIRONMENTAL RADIOACTIVITY AT THE SHIPPINGPORT ATOMIC POWER STATION FOR CALENDAR YEAR 1960. (Pittsburgh Naval Reactors Operations Office, AEC). Mar. 1, 1961. For Pennsylvania Dept. of Health. 9p.

31022 (PNROO-DEV-112) ENVIRONMENTAL RADIOACTIVITY AT THE BETTIS ATOMIC POWER LABORATORY FOR THE FIRST QUARTER OF 1961. (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). May 10, 1961. For Pennsylvania Dept. of Health. Contract AT(11-1)-Gen-14. 8p.

Measurements of radioactivity in the liquid effluent and fall-out, as well as measurements of background radiation intensities at the boundaries of the Bettis Atomic Power Laboratory during the First Quarter of 1961, show no significant contribution by laboratory operations to environmental radioactivity levels. (auth)

31023 (PNROO-DEV-113) ENVIRONMENTAL RADIOACTIVITY AT THE SHIPPINGPORT ATOMIC POWER STATION FOR THE FIRST QUARTER OF 1961. (Pittsburgh Naval Reactors Operation Office, AEC). 9p.

The results of radioactivity measurements made in the Ohio River, atmosphere, soil, and fall-out in the vicinity of the Shippingport Atomic Power Station confirmed that the plant did not contribute significant quantities of radioactivity to the environment. All values were within the permissible concentrations recommended by the National Committee on Radiation Protection and the state of Pennsylvania. (P.C.H.)

31024 (TID-13447) FMPC ENVIRONMENTAL MONITORING QUARTERLY REPORT, APRIL, MAY, JUNE 1960. (National Lead Co. of Ohio, Cincinnati). Aug. 8, 1960. Contract AT(30-1)-1156. 7p.

The environmental monitoring program for the sampling of air and water during the second quarter of 1960 in the vicinity of the Feed Materials Production Center (FMPC), Fernald, Ohio, is presented. The amount of material released to the environment was very low in comparison to the maximum permissible levels, as recommended by the National Committee on Radiation Protection and Measurements and the State of Ohio. (auth)

31025 (TID-13448) FEED MATERIALS PRODUCTION CENTER ENVIRONMENTAL MONITORING QUARTERLY REPORT, JULY-AUGUST-SEPTEMBER, 1960. (National Lead Co. of Ohio, Cincinnati). Nov. 10, 1960. Contract AT(30-1)-1156. 10p.

31026 (TID-13449) FEED MATERIALS PRODUCTION CENTER ENVIRONMENTAL MONITORING QUARTERLY REPORT, OCTOBER-NOVEMBER-DECEMBER, 1960, AND SUMMARY REPORT FOR 1960. (National Lead Co. of Ohio, Cincinnati). Jan. 10, 1961. Contract AT(30-1)-1156. 13p.

The environmental monitoring program for the sampling of air and water is presented. The amount of material released to the environment was small in comparison to the maximum permissible levels recommended by the National Committee on Radiation Protection and Measurements and the State of Ohio. (auth)

31027 (TID-13450) FEED MATERIALS PRODUCTION CENTER ENVIRONMENTAL MONITORING QUARTERLY REPORT, JANUARY-FEBRUARY-MARCH, 1961. (National Lead Co. of Ohio, Cincinnati). Apr. 10, 1961. Contract AT(30-1)-1156. 12p.

31028 (TID-13829) SUMMARY OF ENVIRONMENTAL MONITORING FOR FIRST QUARTER 1961. (Mound Lab., Miamisburg, Ohio). Apr. 28, 1961. Contract AT(33-1)-Gen-53. 22p.

The concentration of radioactive materials detected in the environment is presented. The concentration of polonium and tritium in the Great Miami River was well within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. The concentration of polonium and plutonium in the environmental air was also well within the maximum permissible level. There was no detectable concentration of tritium in the environmental air during the quarter. (auth)

31029 (TID-13834) EVALUATION OF RADIOLOGICAL CONDITIONS IN THE VICINITY OF HANFORD FOR 1960. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Contract AT(45-1)-1350. 12p.

Data on environmental monitoring of the Hanford area are presented and discussed. Analyses were made on air, water supplies, the Columbia River, fish, waterfowl, and milk. The measurements show that the levels are below those specified by the NCRP. (P.C.H.)

31030 (TID-13837) S1C PROTOTYPE REACTOR FACILITY. Quarterly Environmental Monitoring Report, October–December 1960, Volume I, Number 4. (Combustion Engineering, Inc. Naval Reactors Div., Windsor, Conn.). Jan. 1961. Contract AT(30-3)-519. 9p.

Measurements of radioactivity, in the Farmington River, the industrial waste effluent from the plant, air, and fall-out, in the S1C Prototype vicinity, during the fourth quarter 1960 showed no significant contribution of radioactivity from the S1C Prototype to the environment. Radioactivity discharged to the environment, under controlled conditions, from the S1C Prototype, during waste disposal operations, were in full compliance with the recommendations of the National Committee on Radiation Protection and the radiation protection standards established by the Federal Radiation Council. (auth)

31031 (TID-13838) S1C PROTOTYPE REACTOR FACILITY. Annual Summary S1C Prototype Reactor Facility Environmental Monitoring Report, January–December 1960, Volume I, Number 5. (Combustion Engineering, Inc. Naval Reactors Div., Windsor, Conn.). Jan. 1961. Contract AT (30-3)-519. 12p.

Approximately 7.78 mc of beta-gamma radioactivity was released during the year 1960 in liquid waste effluent and dilution water. The average concentration released was 8.0×10^{-7} uc/cc, this compares with the recommendations of the National Committee on Radiation Protection Standards, 2×10^{-6} uc/cc, for the radioisotopes involved. The Farmington River was sampled monthly at various locations upstream, and downstream of the industrial waste outlet, and at the outlet. The average of the river results for 1960 indicated values of 3.0×10^{-8} uc/cc, 6.1×10^{-9} uc/cc, and 8.9×10^{-9} uc/cc beta-gamma at the upstream, outlet, and downstream locations, respectively. Radioactive fallout was collected on a weekly basis at six locations around the site

(on-site) and analyzed for gross beta radioactivity. Radioactive fallout was also collected at eleven off-site locations in neighboring towns and analyzed for gross beta radioactivity. Comparison of the 1960 yearly average of all on-site sampling stations 1.85 mc/mi^2/month and all off-site sampling stations 1.63 mc/mi^2/month were essentially equal and of low level. Airborne waste effluent was monitored at the point of release for beta-gamma radioactivity indicated an average concentration of 5.6×10^{-11} uc/cc, for the year 1960. This compared with the recommendations of the National Committee on Radiation Protection Standards, 1×10^{-10} uc/cc, for the radioisotopes involved. Air samples taken downwind of the point of release during the year 1960 indicates an average of 2.0×10^{-11} uc/cc beta-gamma. Measurements of radioactivity in the Farmington River, the industrial waste effluent from the plant, air, and fallout, in the S1C Prototype vicinity, during the year 1960 showed no significant contribution of radioactivity from the S1C Prototype to the environment. Radioactivity discharged to the environment under controlled conditions from the S1C Prototype, during waste disposal operations, were in full compliance with the recommendations of the National Committee on Radiation Protection and the radiation protection standards established by the Federal Radiation Council. (auth)

31032 (TID-13839) S1C PROTOTYPE REACTOR FACILITY. Quarterly Environmental Monitoring Report, January–March 1961, Volume II, Number 1. (Combustion Engineering, Inc. Naval Reactors Div., Windsor, Conn.). Apr. 1961. Contract AT(30-3)-519. 9p.

Approximately 0.74 mc of beta-gamma radioactivity was released during the first quarter 1961 in liquid waste effluent and dilution water. The average concentration released was 5.5×10^{-7} uc/cc, this compared with the recommendations of the National Committee on Radiation Protection Standards, 2×10^{-6} uc/cc, for the radioisotopes involved. The Farmington River was sampled monthly at various locations upstream, and downstream of the industrial waste outlet, and at the outlet. The average of the river results indicated values of 9.1×10^{-9} uc/cc, 9.1×10^{-9} uc/cc, and 3.1×10^{-9} uc/cc beta-gamma at the upstream, outlet, and downstream locations, respectively. Radioactive fallout was collected on a weekly basis at six locations around the site (on-site) and analyzed for gross beta radioactivity. Radioactive fallout was also collected at eleven off-site locations in neighboring towns and analyzed for gross beta radioactivity. Comparison of the first quarterly averages of all on-site sampling stations indicated 0.63 mc/mi^2/month and 1.44 mc/mi^2/month for all off site sampling stations. Airborne waste effluent was monitored at the point of release for beta-gamma radioactivity indicated an average concentration of 5.5×10^{-11} uc/cc, for the first quarter 1961. This compared with the recommendations of the National Committee on Radiation Protection Standards, 1×10^{-10} uc/cc, for the radioisotopes involved. Air samples taken downwind of the point of release during the first quarter 1961 indicated an average of 1.6×10^{-11} uc/cc beta-gamma. Measurements of radioactivity in the Farmington River, the industrial waste effluent from the plant, air, and fallout, in the S1C Prototype vicinity, during the first quarter 1961 indicated no significant contribution of radioactivity from the S1C Prototype to the environment. Radioactivity discharged to the environment under controlled conditions from the S1C Prototype, during waste disposal operations, were in full compliance with the recommendations of the National Committee on Radiation Protection and the radiation protection standards established by the Federal Radiation Council. (auth)

31033 (TID-13841) QUARTERLY ENVIRONMENTAL MONITORING REPORT, JULY–SEPTEMBER 1960. Volume 2, Number 3. (Knolls Atomic Power Lab., Schenectady, N. Y.). Oct. 1960. Contract W-31-109-Eng-52. 14p.

Studies of the local environment at both the Knolls Site and West Milton Site indicate that the operations at these installations did not produce radioactivity levels which exceeded applicable standards established by the Atomic Energy Commission, based on the recommendations of the National Committee on Radiation Protection and Measurements. (auth)

31034 (TID-13842) QUARTERLY ENVIRONMENTAL MONITORING REPORT, OCTOBER–DECEMBER 1960. Volume 2, Number 4. (Knolls Atomic Power Lab., Schenectady, N. Y.). Jan. 1961. Contract W-31-109-Eng-52. 13p.

Studies of the local environment at both the Knolls Site and West Milton Site indicate that the operations at these installations did not produce radioactivity levels that exceed the applicable standards established by the Federal Radiation Council and the Atomic Energy Commission. During 1960 a total of 108 millicuries and 1.9 millicuries of beta radioactivity were dicharged to the Mohawk River and Glowegee Creek, respectively. Continued monitoring of creek and river water, airborne radioactivity, and soil indicate that there is no deviation from normal background radioactivity. (auth)

31035 (TID-13843) ANNUAL ENVIRONMENTAL MONITORING REPORT, JANUARY–DECEMBER 1960. Volume 2, Number 5. (Knolls Atomic Power Lab., Schenectady, N. Y.). Jan. 1961. Contract W-31-109-ENG-52. 13p.

Studies of the local environment at both the Knolls Site and West Milton Site indicate that the operations at these installations did not produce radioactivity levels that exceed the applicable standards established by the Federal Radiation Council and the Atomic Energy Commission. During 1960 a total of 3125 millicuries and 8 millicuries of beta radioactivity were discharged to the Mohawk River and Glowegee Creek, respectively. Continued monitoring of creek and river water, airborne radioactivity, and soil indicate that there is no deviation from normal background radioactivity. (auth)

31036 (TID-13844) QUARTERLY ENVIRONMENTAL MONITORING REPORT, JANUARY–MARCH 1961. Volume 3, Number 1. (Knolls Atomic Power Lab., Schenectady, N. Y.). Apr. 1961. Contract W-31-109-ENG-52. 11p.

Studies of the local environment at both the Knolls Site and West Milton Site indicate that the operations at these installations did not produce radioactivity levels that exceed the applicable standards established by the Federal Radiation Council and the Atomic Energy Commission. During this quarter a total of 2.1 curies and 2.9 millicuries of beta radioactivity were discharged to the Mohawk River and Glowegee Creek, respectively. Continued monitoring of creek and river water and airborne radioactivity indicate that KAPL operations do not adversely affect the local environs. (auth)

31037 (TID-13845) QUARTERLY ENVIRONMENTAL MONITORING REPORT, APRIL–JUNE 1960. Volume 2, Number 2. (Knolls Atomic Power Lab., Schenectady, N. Y.). Aug. 1960. Contract W-31-109-Eng-52. 13p.

Studies of the local environment at both the Knolls Site and West Milton Site indicate that the operations at these installations did not produce radioactivity levels which would exceed applicable standards established by the

Atomic Energy Commission, based on the recommendations of the National Committee on Radiation Protection and Measurements. (auth)

31038 (TID-13847) FMPC ENVIRONMENTAL MONITORING ANNUAL REPORT, 1959. (National Lead Co. of Ohio, Cincinnati). May 1, 1960. Contract AT(30-1)-1156. 16p.

31039 (TID-13848) FMPC ENVIRONMENTAL MONITORING. Quarterly Report, January-February-March 1960. (National Lead Co. of Ohio, Cincinnati). May 1, 1960. Contract AT(30-1)-1156. 6p.

31040 (TID-13849) ENVIRONMENTAL LEVELS OF RADIOACTIVITY FOR THE OAK RIDGE AREA. Report for the Fourth Quarter 1960. H. H. Abee, comp. ([Oak Ridge National Lab., Tenn.]). Mar. 14, 1961. Contract [W-7405-Eng-26]. 15p.

Data on the environmental levels of radioactivity for the Oak Ridge Area are presented and compared with established maximum permissible concentrations. The data show that the Oak Ridge Operations contribute little to the air or ground contamination in the neighborhood of the area controlled by the AEC. Concentrations of radioactivity in the Clinch River were found to be well below the maximum permissible concentration recommended by the NCRP. (P.C.H.)

31041 (TID-13850) ENVIRONMENTAL LEVELS OF RADIOACTIVITY FOR THE OAK RIDGE AREA. Report for First Quarter 1961. ([Oak Ridge National Lab., Tenn.]). Contract [W-7405-Eng-26]. 15p.

31042 (TID-13851) ENVIRONMENTAL RADIOACTIVITY AT ARGONNE NATIONAL LABORATORY, JULY 1960–DECEMBER 1960. (Argonne National Lab., Ill.). Contract [W-31-109-Eng-38]. 21p.

The radioactivity of the environment was determined by measuring the concentrations of radioactivity in air and water samples collected on and up to 100 miles from the Argonne site. Except for a large reduction in the amount of fall-out activity relative to the first half of 1959, the radioactivity in the environment during the second half of 1960 showed little change. Radioactivity found in the surface waters was well below the maximum permissible concentrations. Data are tabulated. (P.C.H.)

31043 (TID-13852) ENVIRONMENTAL RADIOACTIVITY AT ARGONNE NATIONAL LABORATORY, SUMMARY REPORT FOR THE YEAR 1960. (Argonne National Lab., Ill.). Contract [W-31-109-Eng-38]. 21p.

31044 (TID-13853) THE EFFECT OF THE SAVANNAH RIVER PLANT ON ENVIRONMENTAL RADIOACTIVITY. Quarterly Report, April–June 1960. (Du Pont de Nemours (E. I.) and Co. Savannah River Plant, Aiken, S. C.). Contract [AT-(07-2)-1]. 27p.

The very low levels of radioactivity in air, water, vegetation, milk, and aquatic specimens in the immediate vicinity of the Plant were usually too low to be distinguished from natural background or from bomb debris from global weapons testing activities. Although the radioactivity levels in Savannah River water and aquatic organisms adjacent and downstream from the Plant were slightly higher than in comparable materials in the river above the Plant, the concentrations were of no health significance and were negligible in terms of the recommended Radioactivity Concentration Guide levels. (P.C.H.)

31045 (TID-13854) THE EFFECT OF THE SAVANNAH RIVER PLANT ON ENVIRONMENTAL RADIOACTIVITY. Quarterly Report, July–September 1960. (Du Pont de Nemours (E. I.) and Co. Savannah River Plant, Aiken, S. C.). Contract [AT(07-2)-1]. 26p.

The Savannah River Plant maintains a continuous monitoring program to determine the concentration of radioactive materials in a 1200 sq-mile area outside the plant perimeter. Data collected July through Sept. 1960 are tabulated. (C.H.)

31046 (TID-13855) THE EFFECT OF THE SAVANNAH RIVER PLANT ON ENVIRONMENTAL RADIOACTIVITY. Quarterly Report October–December 1960. (Du Pont de Nemours (E. I.) and Co. Savannah River Plant, Aiken, S. C.). Mar. 1960. Contract [AT(07-2)-1]. 11p.

31047 (TID-13856) THE EFFECT OF THE SAVANNAH RIVER PLANT ON ENVIRONMENTAL RADIOACTIVITY. Quarterly Report January–March 1961. (Du Pont de Nemours (E. I.) and Co. Savannah River Plant, Aiken, S. C.). May 1961. Contract [AT(07-2)-1]. 11p.

31048 (TID-13857) ENVIRONMENTAL SURVEY, JULY–SEPTEMBER 1960. ([Dow Chemical Co]. Rocky Flats Plant, Denver). Oct. 14, 1960. Contract [AT(29-1)-1106]. 5p.

Data are tabulated on α and β activity in air samples collected by continuous sampling at the Rocky Flats Plant during the period July through Sept., 1960. (C.H.)

31049 (TID-13858) ENVIRONMENTAL SURVEY—OCTOBER-DECEMBER, 1960. (Dow Chemical Co. Rocky Flats Plant, Denver). Jan. 30, 1961. 9p.

Environmental radioactivity analyses performed during the fourth quarter of 1960 show that the radioactivity measured was comparable with previous measurements and with natural background measurements elsewhere. Measurements were made on soil, air, and surface water samples. (P.C.H.)

31050 (TID-13859) ENVIRONMENTAL CONCENTRATIONS OF RADIOACTIVE MATERIALS NEAR THE PADUCAH PLANT. Report for Second Quarter 1960. (Union Carbide Nuclear Co. Paducah Plant, Ky.). Contract [W-7405-Eng-26]. 9p.

31051 (TID-13860) ENVIRONMENTAL CONCENTRATIONS OF RADIOACTIVE MATERIALS NEAR THE PADUCAH PLANT. Report for 1960. (Union Carbide Nuclear Co. Paducah Plant, Ky.). Contract [W-7405-Eng-26]. 10p.

While some measurable increases in the radioactivity of air and water were found at the Paducah Plant, the concentrations were well below the maximum permissible concentrations recommended by the National Committee on Radiation Protection and Measurements. (P.C.H.)

31052 (TID-13861) ENVIRONMENTAL CONCENTRATIONS OF RADIOACTIVE MATERIALS NEAR THE PADUCAH PLANT. Report for First Quarter, 1961. (Union Carbide Nuclear Co. Paducah Plant, Ky.). Contract [W-7405-Eng-26]. 10p.

31053 (TID-13862) ENVIRONMENTAL MONITORING REPORT, OCTOBER 1, 1960–DECEMBER 31, 1960. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Contract [AT(11-1)-Gen-8]. 12p.

The results of the monitoring of soil, vegetation, water, and air samples for gross alpha and/or beta-gamma activity are tabulated. The methods of analyses are discussed. (P.C.H.)

31054 (TID-13863) ENVIRONMENTAL MONITORING REPORT, JANUARY 1, 1961–MARCH 31, 1961. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Contract [AT(11-1)-Gen-8]. 12p.

31055 (TID-13885) THE EFFECT OF THE SAVANNAH RIVER PLANT ON ENVIRONMENTAL RADIOACTIVITY. Quarterly Report, January through March 1961. (Du Pont de Nemours (E. I.) & Co. Savannah River Plant, Aiken, S. C.). May 1961. 15p.

31056 (USNRDL-TR-334) STONEMAN II TEST OF RECLAMATION PERFORMANCE VOLUME I. THE PRODUCTION, DISPERSAL AND MEASUREMENT OF SYNTHETIC FALLOUT MATERIAL. W. B. Lane and J. D. Sartor (Naval Radiological Defense Lab., San Francisco). June 6, 1960. 61p.

A field test was conducted in 1958 wherein multicurie amounts of radioisotopes were used to prepare ton quantities of synthetic fallout for the evaluation of land reclamation procedures. The processing of the radioisotope La^{140}, the procedures for radio-tagging clay soil, and the measuring of gamma radiation from large contaminated areas are described. The factor for converting gamma radiation measurements to equivalent weights of soil was determined so that decontamination effectiveness could be expressed in mass units. (auth)

31057 (USNRDL-TR-335) STONEMAN II TEST OF RECLAMATION PERFORMANCE. VOLUME II. PERFORMANCE CHARACTERISTICS OF WET DECONTAMINATION PROCEDURES. W. L. Owen, J. D. Sartor, and W. H. Van Horn (Naval Radiological Defense Lab., San Francisco). July 21, 1960. 167p.

A series of tests was conducted to improve the performance of wet decontamination procedures. Synthetic fallout made of tagged processed soils was dispersed over pavements and roofs so as to simulate the deposition of actual fallout resulting from land surface detonations of nuclear weapons. Removal effectiveness and effort data were obtained on motorized flushing and firehosing of paved areas. Direct firehosing with fan-shaped streams and lobbing of standard firestreams were performed on roof areas. The performance of motorized flushing was superior to that of firehosing both from the standpoint of removal effectiveness and effort expended. Portland cement concrete surfaces were consistently easier to clean than asphaltic concrete for either type of decontamination procedure. An improvised street flusher attachment was found to be satisfactory and its performance was competitive with the conventional flusher tested. For roofing surfaces no rougher than composition shingles, lobbing of firestreams from ground level appears to offer the same degree of removal effectiveness as direct hosing at roof level, where roof slopes provide adequate drainage. A mathematical model based upon theoretical considerations has been developed for the comparative evaluation of decontamination methods. (auth)

31058 (USNRDL-TR-337) STONEMAN II TEST OF RECLAMATION PERFORMANCE. VOLUME IV. PERFORMANCE CHARACTERISTICS OF LAND RECLAMATION PROCEDURES. H. Lee, J. D. Sartor, and W. H. Van Horn (Naval Radiological Defense Lab., San Francisco). Jan. 12, 1959. 65p.

A series of tests were conducted to determine the influence of various soil-surface characteristics and repeated method applications on the effectiveness of some basic land reclamation methods. Four soil surfaces were tested: a moist surface with green grass, a tilled moist surface, a dry tilled surface, and a dry hard surface with withered vegetation. A synthetic fallout was produced and dispersed over the test surfaces and the performances in removing layers of soil of a scraper, motorized grader plus scraper, and remote-control bulldozer were evaluated. Soil surface characteristics, moisture content, and technique in the application of the methods influenced the effectiveness of the reclamation methods. Decontamination ratios of 1% or less were obtained through one or more applications by the scraper and the grader plus scraper methods. Based upon the efficiency with which a method could achieve any effectiveness within the test range, scraping was the best method. (auth)

31059 (AEC-tr-4526) STUDY OF STRONTIUM-90 CONTENT OF POTATOES, MILK AND VEGETATION IN THE LENINGRAD REGION (1957-1959). V. P. Shvedov, M. I. Zhilkina, and L. M. Ivanova (Akademiya Nauk S.S.S.R.). 1960. Translated from report A/AC.82/G/L.548. 23p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 15389.

31060 (AEC-tr-4536) STRONTIUM-90 CONTENT OF MILK IN VARIOUS DISTRICTS OF THE USSR IN 1959. V. I. Novgorodtseva and N. I. Borisova (Akademiya Nauk S.S.S.R.). 1960. Translated from report A/AC.82/G/L.544). 8p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 15388.

31061 (AEC-tr-4612) SANITARY REGULATIONS FOR WORK WITH RADIOACTIVE SUBSTANCES AND SOURCES OF IONIZING RADIATION. (Sanitarnye Pravila Raboty s Radioaktivnymi Veshchestvami i Istochnikami Ioniziruyushchikh Izluchenii). Translated from a publication of the State Publishing House of Literature on Atomic Science and Technology, Moscow, 1960. 114p.

Sanitary regulations were developed for the design, construction, remodeling, and operation of laboratories, institutions, and installations designed for work using radioactive substances and sources of ionizing radiation. (M.C.G.)

31062 DEACTIVATION OF RADIO-ISOTOPE CONTAMINATED WATERS. E. Gaspar, K. Likarets, and D. Serban (Inst. of Nuclear Physics, Bucharest). Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz. Studdi cercetari fiz., 12: No. 1, 29-38(1961). (In Rumanian)

Tests were made for determining the retaining efficiency of calcinated diatomite, coal, and concrete for radioisotopes. It was found that granular materials are the most efficient for filtering water contaminated by radioisotopes and that long, small diameter columns have better retaining capacity. (R.V.J.)

31063 A DEFECTIVE RADIOACTIVE SOURCE IN INDUSTRY. W. R. Lee and G. J. Appleton. Ann. Occupational Hyg., 2: 274-7(Nov. 1960).

The personnel monitoring film of a person engaged on γ radiography indicated an unusually high exposure. Investigations revealed that this was due to the film having been left in a drawer near to contaminated equipment. It was found that a sealed source had been broken, and leakage had taken place leading to contamination. Simple wet methods of decontamination were sufficient to reduce radioactivity to a negligible level. Medical examination of exposed personnel, including measurements of body radioactivity, revealed no ill effects. Supervision of the use of sealed sources should include frequent examinations for leakage by the Wipe Test or one of its variants. (Public Health Eng. Abstr., 41: No. 8, 1961).

31064 THE USE OF ELEMENT-PAIRS IN RADIATION HAZARD ASSESSMENT. H. A. Kornberg (General Electric Co., Richland, Wash.). Health Phys., 6: 46-62(Aug. 1961). (HW-SA-1929)

In using ratios of pairs of elements, such as Sr–Ca and Cs–K, to predict contamination levels, it is necessary to relate the ratio in the donor material to that in the acceptor material by means of a coefficient or discrimination factor. If a constant number for any one discrimination factor relating to a donor-acceptor system is used, errors can result because the discrimination factor can change with the degree of mixing of the two elements, with the environment the elements occur in as they move from one link of the biological chain to the next, and with time. Whether these changes are of practical significance in radiation hazard control, particularly where only averages are needed, is unknown. However, experimental and theoretical evidence indicates that variations in discrimination may occur under certain conditions in the field, and thereby could affect the confidence given to predictions of future contamination levels based on current measurements. This paper describes experimental and theoretical studies related to the variability of discrimination, suggesting the need for caution in using ratios, and recommends that contamination levels be reported in terms of conventional units as well as ratios. (auth)

31065 PROBLEMS OF PERSONNEL MONITORING AT A CRITICALITY ACCIDENT. H. F. Henry (Oak Ridge Gaseous Diffusion Plant, Tenn.). Health Phys., 6: 86-93(Aug. 1961).

With respect to personnel monitoring at a criticality incident, the implications of some experimental data are reviewed which show the dependence of the relative positions of an individual, his typical personnel monitoring device, and the excursion which is essentially a unidirectional γ-neutron radiation source. These data show that, for a given exposure, the dose indicated by either a γ- or neutron-sensitive device of the type generally used can vary by factors of at least 3 or 4, due only to the attenuation by the individual's body. Similar data indicate qualitatively the effect of moderation and reflection in affecting the neutron spectrum incident upon the device as compared to that actually incident upon the individual. In view of the uncertainties thus indicated, it is concluded that, although a γ- and neutron-sensitive personnel monitoring device can provide sufficiently accurate data concerning an individual's exposure for record purposes and will be useful for the prompt identification of personnel who have been highly exposed, a monitoring system consisting of blood sodium determinations as calibrated by area type dosimeters is necessary to provide data which are useful in indicating medical treatment. (auth)

31066 HEALTH AND SAFETY COSTS ASSOCIATED WITH THE CONSTRUCTION OF A NUCLEAR REACTOR. Saul J. Harris (Atomic Accessories, Inc., Valley Stream, N. Y.). Health Phys., 6: 94-5(Aug. 1961).

Health and safety requirements underly the design, or testing, of almost every nuclear power reactor component or system design decision; almost every aspect of government regulation of atomic energy, including the creation of a unique federal government supervision; and many aspects of operating costs of a nuclear reactor, including specialized personnel, extraordinary insurance, and special labor and public relations programs. The composite cost of each of the individual costs which are attributable to health and safety may account for from 20 to almost 100% of the entire nuclear power plant cost; the composite cost of the specific health and safety requisities for a pressurized water-type reactor is estimated to be a minimum of 39% of the reactor portion of the construction costs, using data available on costs of systems and components; hidden safety costs, when added to the specific ones, may result in a minimum of 65% of the construction costs of a pressurized-water reactor. For the boiling-water reactor, the health and safety costs add up to 57% of the total construction costs; there are approaches to reactor design which suggest themselves if safety costs are to be reduced and which should result in a reduction of the cost of electricity produced as a result of nuclear fission; there are reactor systems which are being considered and developed which are applying these approaches. Some have progressed to the point where competitive nuclear power is predicted from plants now under construction; if all approaches suggested herein could be combined, in perhaps a new reactor type, nuclear-produced electricity should be obtainable at lowered costs without jeopardizing necessary safety requirements; recognizing the effect on the design and costs of subsequent components from increasing a safety factor in an initial, determinant, system should warn the design engineer to make such initial-design decisions only after complete evaluation of all possible effects; standardization of reactor designs, at least in terms of safety criteria upon which to make decisions, is suggested. (auth)

31067 ON APPROXIMATE DETERMINATION OF ABSORPTION OF INTEGRAL DOSES OF HIGH-ENERGY RADIATION. V. A. Petrov (Pavlov First Medical Inst., USSR). Izvest. Vysshikh Ucheb. Zavedenii, Priborostroenie, 4: 111-14(1961). (In Russian)

The feasibility of determining integral absorbed doses from known depth-dose distributions in media exposed to various types of emissions (ν, n, d, etc.) was investigated. Curves are plotted for depth-dose percentage for 200-kv x ray, 16-Mev electrons, and 190-Mev deuterons. (R.V.J.)

31068 RADIOACTIVE MATERIALS CONTENT OF AIR. NUCLEAR WEAPONS TESTS AND MATHEMATICAL INTERRELATIONSHIP OF ATOMIC ENGINEERING AEROSOLS. M. Hinzpeter (Zentralamt des Deutschen Wetterdienstes, Offenbach/Main, Ger.). Umschau Wiss. u. Tech., 61: 438-41(July 15, 1961). (In German)

The history of nuclear explosions is briefly reviewed, and the locations of the explosions are tabulated. The maximum altitudes of the fission products are plotted as a function of the magnitude of the explosion. The two methods used for the determination of the age of fission products are described, and the residence time of the radioactive aerosols is discussed. (J.S.R.)

31069 BACKGROUND MATERIAL FOR THE DEVELOPMENT OF RADIATION PROTECTION STANDARDS. Report No. 2. (Federal Radiation Council, Washington, D. C.). Sept. 1961. 21p. $0.20(GPO).

A discussion is given of the problem of providing guidance for Federal agencies in activities designed to limit the exposure of members of population groups to radiation from radioactive materials deposited in the body as a result of their occurrence in the environment. The guides are presented in terms of: protection for certain organs in individuals in the general population, as well as averages over suitable samples of exposed groups; principles of control applicable to all radionuclides occurring in the environment; principles by which Federal agencies may establish appropriate concentration values; and specific guidance in connection with exposure to radium-226, iodine-131, strontium-89, and strontium-90. (B.O.G.)

31070 PROTECTIVE SHELTERS. OTS Selective Bibliography. (Office of Technical Services, Washington, D. C.). July 1961. 11p. (SB-469). $0.10(OTS).

Selected references are presented on shelters for protection against air raids, biological warfare, blast, bombs,

chemical warfare, cold weather, hot weather, nuclear radiation, and thermal radiation. (C.H.)

31071 MEDICAL X-RAY PROTECTION UP TO THREE MILLION VOLTS. Recommendations of the National Committee on Radiation Protection and Measurements. National Bureau of Standards Handbook 76. Supersedes H60. (National Bureau of Standards. National Committee on Radiation Protection. Washington, D. C.). Feb. 9, 1961. 59p. (NCRP-26). $0.25(GPO).

The Handbook contains recommendations and data of the National Committee pertaining to persons involved in any way with x radiation. The tables were revised to conform with the present lower maximum permissible dose (MPD) and the differences in the maximum permissible doses allowed in controlled areas and in their environs. Recommendations were altered, deleted, or added as necessary to cover situations created by recent technical advances in machine design and by the development of new radiological techniques. (P.C.H.)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

31072 (NYO-9572) A STUDY OF THE EFFECTS OF SUB-STERILIZATION DOSES OF RADIATION ON THE STORAGE LIFE EXTENSION OF SOFT-SHELLED CLAMS AND HADDOCK FILLETS. Quarterly Progress Report for the Period May–July 1961. John T. R. Nickerson, Samuel A. Goldblith, and Edmund B. Masurovsky (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2329. 33p.

Methods for obtaining maximum aerobic and anaerobic bacterial counts on fresh and irradiated (750,000 rad) shucked, soft-shelled clams and haddock fillets were investigated. This involved an evaluation of the composition and temperature of the dilution water, the composition of various culture media, the culture incubation temperature, and the culture incubation time. On the basis of the results of tests to determine the most suitable methods of counting, procedures and materials were selected for obtaining maximum aerobic bacterial counts and maximum counts for Clostridia in fresh and irradiated shucked, soft-shelled clams and haddock fillets. The bacterial content of shucked, soft-shelled clams from three plants, and of haddock fillets from three plants, was determined over a period of approximately one month. This survey involved the examination of three samples daily from each plant. While bacterial counts indicated that the product produced in some clam-shucking and fish-filleting plants is superior in sanitary quality to that produced in others, no evaluation of different plants will be made until the survey has been completed and all data are available. (auth)

31073 (SRO-47) DETERMINATION OF THE UNIFORMITY OF MIXING OF PORTLAND CEMENT AND BITUMINOUS CONCRETE FOR VARIOUS MIXING TIMES BY THE USE OF RADIOISOTOPES. Annual Report No. 1, December 1, 1960 to March 31, 1961 (Final Technical Report for That Phase of the Program Dealing with Portland Cement Concrete). Clyde Poovey and Donald O. Covault (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station). Apr. 20, 1961. Contract AT(38-1)-202. 98p.

Uniformity of mixing is a good criterion by which to judge the quality of a concrete mix and mixing adequacy. Cement content of mortar, fineness modulus of the aggregate, ultimate compressive strength, and visual inspection of mixing quality were used to indicate uniformity. With the exception of cement content, all determinations of the physical characteristics of the concrete were made by conventional tests as specified by the American Society of Testing Materials. Cement content of the concrete mortar was determined by neutron activation analysis of Ca^{49} produced in the Ca in the portland cement. This method of cement content determination proved very feasible and could be used to predict the cement content within approximately 10% of its true value 95% of the time. Mixing time, batch replication, and position in the concrete mixer generally did not have significant effect upon cement content, fineness modulus, and compressive strength for mixers studied. Mixing times varying from 30 to 180 sec were used in evaluating uniformity of mixing. (auth)

31074 (TID-13868) INVESTIGATION OF THE EFFECTS OF IONIZING RADIATION ON THE SEDIMENTATION OF SEWAGE. Third Quarterly Report. (Universal Match Corp. Armament Div., St. Louis). Sept. 22, 1961. Contract AT(11-1)-905. 50p. (UMC-F61-156)

A 2000-c Co^{60} radiation source was installed. Various methods of measuring sedimentation were investigated. The investigation of the settling characteristics of oil-coated clay particles was continued and oil-clay suspensions were irradiated. The irradiated suspensions had a decreased settling rate at exposures below approximately 240,000 r but for higher doses the settling rate increased. Suspensions of ersatz sewage and several of its components were also irradiated. Preliminary results indicate that the effect of radiation on ersatz sewage mixture is greater than the cumulative effect on its components because interactions take place between components after they have been ionized. The change in settling rate was found to be dependent upon the absorbed dose with both increases and decreases occurring at high dose levels. The results indicate that, with sewage similar to the ersatz sewage, carefully chosen high dose levels could increase sedimentation and kill bacteria simultaneously. (C.H.)

31075 (AEC-tr-4806) PRESERVATION OF SOFT FRUIT WITH THE AID OF IONIZING RADIATION. J. G. van Kooy and D. I. Langerak. Translated by Gifford A. Young (Division of Isotopes Development, AEC) from Kernenerg. in Landbouw, 2: No. 4, 1-5(Jan. 16, 1961). 9p.

Investigations were made of the effects of electron and gamma irradiations on: the extension of storageability of blackberries, raspberries, plums, and strawberries; the vitamin C content in strawberries; and the ripening of tomatoes. (B.O.G.)

31076 (NP-tr-776) THE STORAGE OF X-IRRADIATED POTATOES. A. Berger. Translated by M. H. Rand (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Atompraxis, 6: 301-8(1960). 28p. (Handwritten MS. copy).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 22764.

31077 USE OF RADIOISOTOPES FOR MEASURING THE GRINDING ABILITY. Hiroshi Fushimi (Waseda Univ., Japan). Genshiryoku Kôgyô, 6: No. 1, 19-24(Jan. 1960). (In Japanese)

Radioisotopes were used for studying the movement of balls in ball mills for the purpose of evaluating their grinding ability. About 2 to 3 millicuries of $Co^{60}O$ were placed in the 2-, 3-, and 4-in. diameter balls used in conical commercial ball mills under the usual operational conditions. This allowed the motion of the balls from the outside of the mills to be followed. The study revealed that the movement of the balls and consequently the grinding action was greatly affected by the speed of rotation of the mill, the size distribution and the feed rate of the balls, and of the raw material to be ground, presenting formerly unsuspected correlations between these factors. The method is thus deemed to be very effective for evaluating the operation of ball mills. (TTT)

31078 MACHINING OPERATIONS BY USING EXTRA-HARD RADIOACTIVE TOOLS. Toshio Sata (Inst. of Physical and Chemical Research, Japan). Genshiryoku Kôgyô, 6: No. 1, 59-65(Jan. 1960). (In Japanese)

An extra-hard tool containing about 13 millicurie/g of the radioactive W^{187} was used for determining the useful service life and the machining ability of the material. The tests were carried out by determining the radioactivity of shavings of the test pieces on the basis of which a correlation could be established between abrasion and service life of the tool. The method was found to be very effective and presented the advantage that it required only one-tenth of the usual testing time and reduced the material requirements by a factor of about 20 to 50. (TTT)

31079 SOME NEW SEALED RADIOACTIVE PREPARATIONS FOR INDUSTRIAL AIMS. SEALED PREPARATIONS. II. G. Vormum (Isotopenverteilungsstelle, Berlin). Isotopentechnik, 1: 129-32(May 1961). (In German)

Experiments on the preparation of β sources, especially thallium and krypton preparations for volume density measurement, are reported. (tr-auth)

31080 AUTOMATIC NON-CONTACK DENSITY MEASUREMENTS IN COLD-ROLLING MILLS BY THE APPLICATION OF RADIOACTIVE RADIATION. A. Bogachev (Bogatschew) (Central Lab. of Automatization, Moscow). Isotopentechnik, 1: 135-7(May 1961). (In German)

Three densitometers developed and built in the USSR are described. These instruments combine the advantages of a comparison measurement with those of a first value reading either by a compensation method with follower control or by direct measurement with automatic balance. (tr-auth)

31081 DENSITY AND REINFORCEMENT INVESTIGATION OF CONCRETE. E. Pohl (Hoschule fur Bäuwesen, Leipzig). Isotopentechnik, 1: 138-9(May 1961). (In German)

Some specially significant possibilities for the application of radioisotopes in the construction industry are described. Emphasis is given to the determination of the radiation attenuation coefficient for shielding materials, the determination of the site and range of reinforcements in concrete, and density measurements on construction materials. (tr-auth)

31082 THE DETERMINATION OF THE CALORIFIC VALUE OF COAL WITH RADIOACTIVE RADIATION. J. Kakas (Csepel Iron and Metal Works, Budapest), M. Nagy, K. Varga, A. Bisztray-Balku, and A. Levai. Isotopentechnik, 1: 144-6(May 1961). (In German)

Measurements are reported through which it could be established that in coals of various quality from the Pecs district (Sudungarn) there is a rigid dependence between calorific value and density. This dependence makes possible, because of the known dependence of the linear attenuation coefficient of γ radiation (Tm^{170}) on density, the determination of the calorific value by an absorption measurement. (tr-auth)

31083 ASH CONTENT DETERMINATION OF LIGNITE BY MEANS OF β BACKSCATTERING. E. Dahn (Institut für angewandte Radioaktivität, Leipzig). Isotopentechnik, 1: 150-1(May 1961). (In German)

Investigations on the determination of the ash content of lignite with the help of β backscattering measurements are reported. With 50 μc $Sr^{90} + Y^{90}$, several lignite samples with various contents of sand, clay, or pyrite were measured, and the change of the intensity of the backscattered β radiation was determined as a function of ash content. Filtration of the backscattered radiation increased the sensitivity. (tr-auth)

31084 CONTINUOUS LEVEL MEASUREMENTS WITH POINT-SHAPED EMITTERS. K. Irmer (Technische Hochschule, Dresden). Isotopentechnik, 1: 151-3(May 1961). (In German)

Formulas were derived which permit the calculation of the arrangement and activity of point-shaped emitters if an almost linear dependence between pulse density and level height can be obtained for horizontal and vertical cylindrical containers. (tr-auth)

31085 EXPERIENCES WITH LEVEL CONTROL INSTALLATIONS OF THE VA-T-64 TYPE IN THE VEB MINERALOLWERK LUTZKENDORF. H. Roth (VEB Mineralölwerk Lützkendorf, Ger.). Isotopentechnik, 1: 153-5(May 1961). (In German)

The technological conditions which have led to the application of radioisotopes to level measurements are reported. Weak points occurring in the operations of the model and their solutions are shown. Advantages from increased operational safety are indicated. (tr-auth)

31086 APPLICATION OF RADIOACTIVE ISOTOPES IN TRANSPORT IN LIGNITE MINING. W. Häusler (VEB Braunkohlenkombinat Lauchhammer, Ger.). Isotopentechnik, 1: 155-6(May 1961). (In German)

Three tested applications of radiation barriers in lignite mining are described. These are the braking of a train when it passes a stop signal, rear signalling, and for the automatic control of block signals. (tr-auth)

31087 TRITIUM IN INDUSTRY AND TECHNOLOGY. K.-H. Segel (Institut für Medizin und Biologie, Berlin). Isotopentechnik, 1: 169-71(May 1961). (In German)

The special tracer properties of tritium and labeling and measurement methods for this isotope are described. Some examples for the application of tritiated compounds are given. (tr-auth)

ISOTOPE SEPARATION

31088 (NYO-2134) DESIGN ASPECTS OF PLANT FOR PRODUCTION OF HEAVY WATER BY DISTILLATION OF HYDROGEN. (Little (Arthur D.) Inc., Cambridge, Mass.). Dec. 11, 1957. Contract AT(30-1)-1742. 66p. (ALI-C-59251)

A program was carried out to clarify certain design aspects of a plant for the production of heavy water by the distillation of hydrogen. The following areas were investigated: over-all thermodynamic design, the determination of late developments in insulation techniques and their application to the plant design, and the operability of a reversing heat exchange for the final stage of nitrogen purification by condensation to the solid phase from a hydrogen stream. Cycle design, thermal properties of insulation, and reversing heat exchanges for nitrogen removal are discussed. It was concluded that plant investment and operating costs could be considerably reduced through modification of the cold-box arrangement. (M.C.G.)

31089 (AEC-tr-4822) ULTRACENTRIFUGE FOR THE SEPARATION OF A GAS MIXTURE INTO TWO COMPONENTS AND METHOD OF MANUFACTURE FOR SUCH A CENTRIFUGE. Translated for Oak Ridge Gaseous Diffusion Plant, Tenn., from Dutch Patent No. 87,740, Mar. 15, 1958. 8p.

An invention is described for separating gas mixtures into two components by ultracentrifugation. The apparatus consists of a cylindrical vessel with central spindles through which the conduits for feed and discharge extend. Methods for fabrication of the apparatus are given along with data on performance. (J.R.D.)

31090 (AEC-tr-4827) INVESTIGATION OF THE SEPARATION OF BORON ISOTOPES. I. Kiss, I. Opauszky, and L. Matus. Translated by A. L. Monks (Oak Ridge National Lab., Tenn.) from Roczniki Chem., 34: 385-9(1960). 5p.

The separation of boron isotopes by chemical exchange between BF_3 and its organocomplexes as well as by rectification of these complexes and of boron trialkyl esters was studied. (auth)

31091 A PREPARATION OF HIGHLY CONCENTRATED NITROGEN-15 BY EXCHANGE OF NO AND N_2O_3. E. U. Monse, T. I. Taylor, and W. Spindel (Columbia Univ., New York). J. Phys. Chem., 65: 1625-7(Sept. 1961).

Experiments with a cascade of two columns which yielded 99.7% nitrogen-15 are described. The over-all separation $S = (N^{15}/N^{14})_{product}/(N^{15}/N^{14})_{feed}$ where N^{15}/N^{14} refers to the ratio of the mole fraction of nitrogen-15 to the mole fraction of nitrogen-14, was 2780 for column (II) and 90700 for the entire cascade. From the relation, $S = \alpha^n$, the number of stages, n, calculated for column (II), was 260, corresponding to the height of column equivalent to a theoretical plate (H.E.T.P.) of 1.15 cm. It was found that the experiments demonstrate the feasibility of using NO-N_2O_3 exchange for preparing highly concentrated nitrogen-15 on a laboratory scale and verify previous estimates of the sizes of columns required. The one disadvantage of the system was that it needed to be refrigerated at approximately −10°. (P.C.H.)

31092 THE INFLUENCE OF ION CURRENTS' DENSITIES ON THE STRUCTURE AND CONCENTRATION OF ISOTOPIC TARGETS RECEIVED FROM ELECTROMAGNETIC SEPARATORS. M. I. Guseva and B. V. Aleksandria. Zhur. Tekh. Fiz., 31: 867-75(July 1961). (In Russian)

The dependence of the structure and concentration of Si^{30} and Ag^{109} targets prepared in an electromagnetic separator on the current densities has been investigated. It is shown that the concentration growth of the isotopes as the current strength is decreased to a few tenths or a few microamperes (depending on the ion system) is caused by the lowering of the dispersion coefficient of the copper collector by the particular ions. Microstructural and electronographical phase analyses of the targets showed that under these conditions the surface of the collectors acquire thin films composed of isotopic atoms and their oxides. In a similar way thin films of most of the heavy element isotopes were obtained using metallic collectors. (TTT)

31093 IMPROVEMENTS IN OR RELATING TO CATALYTIC ISOTOPIC EXCHANGE APPARATUS. William Havelock Denton and Douglas Handley (to United Kingdom Atomic Energy Authority). British Patent 877,089. Sept. 13, 1961.

A catalytic isotope exchange apparatus is designed for reacting H_2 and steam at high temperatures to produce deuterium. The apparatus substantially reduces losses due to back-reaction. (D.L.C.)

31094 RECTIFIED ABSORPTION METHOD FOR THE SEPARATION OF HYDROGEN ISOTOPES. Charles D'A Hunt and Donald N. Hanson (to U. S. Atomic Energy Commission). U. S. Patent 3,004,628. Oct. 17, 1961.

A method is described for separating and recovering heavy hydrogen isotopes from gaseous mixtures by multiple stage cyclic absorption and rectification from an approximate solvent. In particular, it is useful for recovering such isotopes from ammonia feedstock streams containing nitrogen solvent. Modifications of the process ranging from isobaric to isothermal are provided. Certain impurities are tolerated, giving advantages over conventional fractional distillation processes. (AEC)

MATHEMATICS AND COMPUTERS

31095 (KAPL-M-EC-4) DAPR I—DATA PROCESSING AND REDUCTION ON THE PHILCO S-2000 DIGITAL COMPUTER. L. E. Weyrick (Knolls Atomic Power Lab., Schenectady, N. Y.). Dec. 22, 1960. Contract W-31-109-Eng-52. 31p.

DAPR I is a computer program which processes data from the logger system of a reactor and power plant. This logger system records a maximum of 432 instrument readings on a logger sheet, and simultaneously punches the data on paper tape. Cards are punched from the tape and become the primary input to DAPR I. Included in DAPR I are secondary data reduction programs written in ALTAC and independently checked out (these may be added by recompiling DAPR I). These secondary programs use various items of data from the logger as their input. When data reduction by a secondary program is desired, the logger cards containing appropriate raw data, the identification of the desired secondary programs, and the respective desired time intervals are fed as input to DAPR I. DAPR I then sorts, selects, scales, and calibrates this data, prepares an input tape in the proper format for each secondary program, and finally transfers control to the automatic operator system (BKS) for calculation of all desired cases for each secondary program. (auth)

31096 (KAPL-M-EC-8) VEP—EIGENVALUE VIBRATION PROGRAM. J. A. Warrington and R. B. McCalley (Knolls Atomic Power Lab., Schenectady, N. Y.). Feb. 28, 1961. Contract W-31-109-eng-52. 34p.

VEP is a digital computer program which solves the classical eigenvalue vibration problem. Specialized matrix manipulations are used to generate symmetric matrices so that the Jacobi diagonalization process may be employed to find the eigenvalues or characteristic frequencies. Extensive solution checking is done. The input matrices, the latent roots, and frequencies as well as the eigenvectors are printed out in fixed and floating point format. (auth)

31097 (KAPL-M-JA-6(Rev.III)) KARE INPUT. REVISION III. (Knolls Atomic Power Lab., Schenectady, N. Y.). June 15, 1961. Contract W-31-109-Eng-52. 73p.

The scope of KARE and its specifications are discussed. The phases, classes, and types of KARE problems are described. Region splitting, contour specification, region overlaying, generation of full plane problems, and iteration schemes are considered. General input, boundary input, increment input, and region dependent input are discussed. (M.C.G.)

31098 (KAPL-M-JA-7(Revs.1 & 2)) KARE GENERAL MESH DATA. J. A. Archibald, Jr. (Knolls Atomic Power Lab., Schenectady, N. Y.). May 6, 1960. Revision I, July 22, 1960. Revision II, July 6, 1961. Contract W-31-109-eng-52. 16p.

Revisions I and II of the Kare general mesh data program are presented. (J.R.D.)

31099 (KAPL-M-NPA-23) PRESSURIZER ANALYSIS AND THE PRE DIGITAL PROGRAM. J. A. Findlay (Knolls Atomic Power Lab., Schenectady, N. Y.). July 14, 1961. Contract W-31-109-eng-52. 121p.

An analysis is given which was programmed for the Philco 2000 (TRANSAC) Computer in order to provide a means for making pressurizer design and performance calculations. The analysis and digital program provide the flexibility for studying the effects of various assumptions such as the type of steam compression process (i.e., isentropic or saturation), spray efficiency, wall condensation, and mixing of the pressurizer water and of the insurge. Also included in the program are data on pressure controlled steam and water relief valves (total of four), pressure controlled heaters (total of five), pressure controlled spray valve, and various input formats allowing the use of either total surge, surge rate or bulk average temperature for the surge, spray fraction or spray rate for the spray and either temperatures or enthalpies for the surge and spray energies. The program uses steam and water properties in the form of empirical equations where the empirical constants in these equations may be changed depending upon the range of interest of the problem. (auth)

31100 (NDA-2092-5) A DESCRIPTION OF MONSTER, A DIGITAL COMPUTER PROGRAM FOR A MONTE CARLO REACTOR SHIELDING CALCULATION. Florence Jeanne Oswald, Roberta Schaffer, and Hermann V. Waldinger (Nuclear Development Corp. of America, White Plains, N. Y.). June 1958. For General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati. Contract [AT(11-1)-171], Subcontract (AT74)-ANPG-05339. 74p.

A description and detailed flow charts are presented for MONSTER, a digital computer program which uses Monte Carlo methods to simulate the life histories of gammas and neutrons in a reactor. The function of the code is to supply the following information: neutron and gamma leakage spectra and angular distribution from the entire shield in terms of a point source equivalent to the core-shield configuration, neutron and gamma currents by lethargy or energy group across specified boundaries, energy deposition in specified regions, the number of gamma sources in specified regions, the number of absorptions in each region. and a tabulation by region of the number of neutrons or photons that scatter into a lethargy or energy below the cut-off for the problem. (M.C.G.)

31101 (NYO-9497) ITERATION METHODS FOR NONLINEAR PROBLEMS. Samuel Schechter (New York Univ., New York. Atomic Energy Commission Computing and Applied Mathematics Center). May 1, 1961. Contract AT(30-1)-1480. 22p.

The methods of successive displacements or relaxation methods are investigated for a class of nonlinear problems. In particular it is shown that these methods are applicable to a large class of nonlinear problems arising from variational problems which yield elliptic equations. Constructive existence and uniqueness theorems are presented for the discrete problem and criteria are given for a practical method of obtaining solutions. The example of a discrete Plateau problem is used to illustrate the feasibility of the results. The processes are also shown to apply to uniformly elliptic problems. (auth)

31102 (ORNL-2789) CORN PONE: A MULTIGROUP, MULTIREGION REACTOR CODE. W. E. Kinney and R. R. Coveyou (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. 180p. Sept. 15, 1961.

Corn Pone is an Oracle multigroup, multiregion, one-dimensional P_1 reactor code for slab, cylindrical, or spherical geometry. The numbers of groups and space points are not limited for practical purposes. There may be 128 regions each having its own epithermal and thermal groups. The equations reduce simply to Diffusion Theory

equations and slowing down may be treated by Fermi, Wigner, or Goertzel-Greuling kernels. Disadvantage factors may be computed and applied. Regions and element events, sources, cross sections, flux spatial integrals, fluxes and currents may be edited, that is, individually extracted from the program and printed or displayed. Running time is 6 minutes per iteration for a 32-group, 2-region, and 56-space point case. Averaged cross sections may be put directly on the Corn Pone Group Constant Tape or cross section graphs may be stored on tape and then integrated over a specified group structure. Infinite, homogeneous medium, P_1 age and Fourier transform codes are available and require 5 minutes to punch values for 31 groups. The development of the theory from a set of differential equations to a set of difference equations suitable for machine computations is traced, complete instructions for use are given, and finally, methods and approximations used in the code are evaluated. (auth)

31103 (SCR-422) A PROGRAM FOR CALCULATING HYPERGEOMETRIC PROBABILITY DISTRIBUTION TABLES ON THE IBM 704 EDPM. M. Katherine Weston (Sandia Corp., Albuquerque, N. Mex.). July 1961. 20p.

A SHARE coded program is presented for tabulating the hypergeometric probability distribution for lot sizes less than or equal to 2000. Included are method of computation, instructions for using the program, a copy of the assembled program, and a sample of the computed data in format. (auth)

31104 (SCR-423) NORMAL PROBABILITY INTEGRAL ROUTINE—FLOATING OR FIXED POINT. Zelma E. Beisinger (Sandia Corp., Albuquerque, N. Mex.). Aug. 1961. Contract [AT(29-1)-789]. 21p.

A fast subroutine for the IBM 704 EDPM to compute the normal probability integral is described. The input and output may be either floating or fixed point single-precision numbers. The results of computations by this program were compared with the 15-digit NBS table. No discrepancies were noted larger than 10^{-8} for the floating point results or 10^{-10} for the fixed point results. (M.C.G.)

31105 (SCR-428) RANDOM PERMUTATIONS OF SELECTED POWERS OF 2 AND 3. H. E. Anderson (Sandia Corp., Albuquerque, N. Mex.). Aug. 1961. Contract [AT(29-1)-789]. 130p.

Ten tables of random permutations of the powers of 2 and 3 in the range 3^1 through 2^7 are presented. Applications and method of generating the tables are described. (auth)

31106 (SCTM-114-61(25)) A NOMOGRAPH FOR SINGLE-SAMPLING PLANS BY ATTRIBUTES. R. V. Panos (Sandia Corp., Albuquerque, N. Mex.). June 1961. Reprinted Aug. 1961. 16p. Contract [AT(29-1)-789].

A rapid method is given for solving problems dealing with single-sampling plans by attributes. Approximate answers, based on the binomial distribution, are given to problems such as: given the sampling plan, find the AQL, LTPD, and AOQL; or, conversely, if any two of the AQL, LTPD, or AOQL are known, find an approximate sampling plan. Examples showing how to use the material and a brief explanation of the theory of acceptance sampling by attributes are included. (auth)

31107 (TID-13782) TECHNICAL PROGRESS REPORT. PART I. HIGH-SPEED COMPUTER PROGRAM. PART II. CIRCUIT RESEARCH PROGRAM. PART III. DATA REDUCTION METHODS. PART IV. ILLIAC USE AND OPERATION. PART V. IBM 650 USE AND OPERATION. PART VI. GENERAL LABORATORY INFORMATION. (Illinois. Univ., Urbana. Digital Computer Lab.). June 1961. Contract AT(11-1)-415. 62p.

Details of high-speed computer developments are given. In circuit research, design of a multi-phase transfer system is reported in which each stage is self-clocked, and incoming signals may be used to switch tunnel diodes and produce in short-circuited coaxial lines an inverted reflected signal. A summary of new Illiac codes and usage is presented and use of the IBM 650 is summarized. (J.R.D.)

31108 (WAPD-TM-277) SEAL-SHELL—A DIGITAL PROGRAM TO DETERMINE STRESSES AND DEFLECTIONS IN AN AXISYMMETRIC SHELL OF REVOLUTION. C. M. Friedrich (Westinghouse Electric Co. Bettis Atomic Power Lab., Pittsburgh). Sept. 1961. Contract AT-11-1-GEN-14. 52p.

SEAL-SHELL, a FORTRAN II program registered as code number M0077 at Bettis Atomic Power Laboratory, is written for the Philco 2000 computer with two tape units. The program is designed to determine loads, deflections, and stresses in a thin shell of revolution under axisymmetric end loads and pressure. (auth)

31109 AN EXPONENTIAL BOUND ON THE STRONG LAW OF LARGE NUMBERS FOR LINEAR STOCHASTIC PROCESSES WITH ABSOLUTELY CONVERGENT COEFFICIENTS. L. H. Koopmans (Sandia Corp., Albuquerque, N. Mex.). Ann. Math. Statist., 32: 583-6(June 1961). (SCR-297)

The following theorem is established and proved: for every ϵ greater than zero there exist constants A and ρ smaller than one such that $P\{|n^{-1}S_n - \mu| \geq \epsilon \text{ for some } n \geq m\} \leq A\rho^m$. (N.W.R.)

31110 FOURIER TRANSFORMS. Richard R. Goldberg. Cambridge Tracts in Mathematics and Mathematical Physics. No. 52. Cambridge, Eng., At The University Press, 1961. 82p.

The Fourier transform is introduced on L^1. After determining its fundamental properties, it is proved that an analytic function of a Fourier transform is locally a Fourier transform. An "algebraized" reformation of preceding results is given in terms of ideals in a commutative Banach algebra. The Fourier transform on L^2 is given, and Plancheral's theorem is proved. Proof and generalization of Wiener's theorem are offered, and the problem of whether the zeros of the Fourier transform of an L^1 function determine the span of the translates of the function is discussed. Bochner's characterization of Fourier-Stieltjes transforms of non-decreasing bounded functions is presented. (L.N.N.)

31111 THE LANCE REACTOR ANALOGUE COMPUTER. R. F. Mathams (Associated Electrical Industries, Ltd., Aldermaston, Berks, Eng.). p.111-15 of "Seminar on Analogue Methods in Nuclear Energy Problems, Actes—Proceedings, Brussels, April 21-23, 1960." Brussels Presses Academiques Europeennes, 1961. (In English)

A medium-sized reactor analog computer is described. The neutron kinetics circuit is a modified version of Pagel's original circuit with the following special features: (a) The negative and positive output voltages are in the ratio 5:1 respectively, and this is also the ratio of negative and positive reactivity ranges. This enables maximum use to be made of the resolution of the reactivity potentiometers. (b) Additional capacitors are provided in the kinetics circuit to enable it to work in an extended time scale of 10s:1s to observe fast transient or alternatively to enable the scale factor of output volts/watt (reactor power) to be automatically reduced during the course of a startup computation. A logarithmic amplifier is provided which operates on a pulse width modulation system and is designed to cover a range of three decades of reactor

power. This range is artificially extended to a maximum of eleven decades by means of the automatic re-scaling facility of the neutron kinetics section. Electro-mechanical integrators are used for long term computations such as Xe^{135} poisoning to avoid errors due to grid currents in electronic amplifiers. The gear ratios of these electro-mechanical integrators may be reduced by a factor of 3600, thus enabling them to operate in a shortened time scale of 1s : 1h without changing electrical components. (auth)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

31112 (DMIC-Memo-127) REVIEW OF RECENT DEVELOPMENTS IN THE TECHNOLOGY OF TUNGSTEN. Period covered, May through August, 1961. V. D. Barth (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Sept. 22, 1961. 9p.

A review is presented of developments in tungsten technology for the period May through August 1961. The review is given in terms of: consolidation and fabrication; oxidation and protection; and properties. 16 references. (B.O.G.)

31113 (DMIC-Memo-129) REVIEW OF RECENT DEVELOPMENTS IN THE TECHNOLOGY OF MOLYBDENUM AND MOLYBDENUM-BASE ALLOYS. J. A. Houck (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Oct. 6, 1961. 5p.

A review is presented of recent developments in the metallurgy of molybdenum and molybdenum-base alloys taken from literature received by DMIC from June 30 to Sept. 30, 1961. (B.O.G.)

31114 (NP-10724) THERMOELECTRIC MATERIALS AND DEVICE RESEARCH. Quarterly Progress Report No. 3, March 18, 1960–June 17, 1960. B. R. Gossick and H. B. Whitehurst (Arizona State Univ., Tempe). Contract DA36-039 SC-85249. 14p.

Research is being carried out to produce a material which is stable at high temperatures and which has a high thermoelectric figure of merit. The first material investigated for the purpose of developing these properties was rutile modified by the inclusion of suitable colloidal particles. The methods which were developed for purification of the precipitated TiO_2 used in these experiments are described. The methods of preparing high melting point metals in colloidal form are also described, together with the procedures used to mix these particles into a matrix of TiO_2. Theoretical consideration of the principles involved in the electrical behavior of two-phase systems is reviewed. The work being done on the systems for evaluation of new materials is reported together with experiments which were carried out to establish macroscopic metal-to-rutile junctions. (auth)

31115 (NP-10757) PROGRESS REPORT NO. 1, [ON URANIUM RESEARCH]. (British Columbia. Univ., Vancouver). Jan. 1961. 15p. (CURF R-2)

Investigations were made of the semiconductor properties of uranium dioxide. The effects of oxide additions on the electric conductivity of uranium dioxide were studied. Lattice parameters were reported for several UO_2–MgO compositions. (B.O.G.)

31116 (NP-10768) THE NON-ATOMIC USES OF URANIUM. A Bibliography of Metallurgical Abstracts. Charles E. Makepeace (Eldorado Mining and Refining Ltd., Ottawa). Feb. 1, 1960. 202p. (CURF B-2)

A literature search was made on the non-atomic uses of uranium. A list of 293 references with abstracts is presented. Literature from 1947 to 1959 was covered. Subject and numerical indexes are included. (M.C.G.)

31117 (NP-10771) THE PRODUCTION OF TITANIUM–URANIUM AND IRON–URANIUM MASTER ALLOYS IN THE CONSUMABLE-ELECTRODE VACUUM-ARC FURNACE. H. V. Kinsey (Canada. Dept. of Mines and Technical Surveys. Mines Branch). Jan. 26, 1961. 13p. (PM-T-60-12; CURF R-5)

High uranium alloys of titanium and iron were prepared using consumable-electrode vacuum-arc melting. Electrode and ingot production are described. (M.C.G.)

31118 (NP-10772) RESEARCH ON NON-NUCLEAR USES OF URANIUM. Progress Report No. 4, January 1–April 30, 1961. (Canada. Dept. of Mines and Technical Surveys. Mines Branch). Apr. 30, 1961. 21p. (PM-R-61-13; CURF R-7).

Summaries are presented on research in the following areas: high-temperature oxidation of uranium steels and iron–uranium alloys; the effects of uranium-alloying additions on the corrosion resistance of steels in aqueous solutions; the effects of uranium additions to ferrous metals; the deoxidation of mild steel using uranium; the effects of uranium on the static fatigue and stress corrosion of carbon steel and alloy steels; strain aging of steels; the effects of additions of chromium, molybdenum, titanium, and nickel on the microstructure of uranium steels; the effects of uranium on temper embrittlement; the effects of uranium on the high-temperature properties and hardenability of steam turbine steels; the effects of uranium in nodular iron; the effects of uranium additions on aluminum alloys; the effects of uranium additions to copper and its alloys; and notes on the safe handling of uranium alloys in industry. (B.O.G.)

31119 (NRL-5661) AN OPTICAL TECHNIQUE FOR THE MEASUREMENT OF PLASTIC BENDING STRAINS AT ELEVATED TEMPERATURE. G. J. Danek, Jr., H. H. Smith, and M. R. Achter (Naval Research Lab., Washington, D. C.). June 13, 1961. Contract AT(49-5)-1907. 6p.

In connection with a study of high-temperature fatigue properties in controlled environments, an optical method based on the determination of the radius of curvature of a strained sheet-metal specimen has been developed for measuring bending strains in the plastic range at 1500°F. In order to establish the accuracy of the method, the optical strain measurements were compared with those made with a resistance strain gage at room temperature on nickel, Type 316 stainless steel, and Inconel X. At 1500°F, the standard which was chosen for comparison was stress calculations applied to Inconel X. In the current state of evaluation of the technique, the data which are being used for the purpose of reporting fatigue results are considered reliable to five percent. (auth)

31120 NUCLEAR PURITY AND THE PRODUCTION OF URANIUM. P. Vertès (Commissariat á l'Energie Atomique, [Paris]). Énergie nucléaire, 3: 199-209(May-June 1961). (In French)

In a consideration of the production of "nuclear grade" uranium, it is difficult to separate the chemical, technical, and economic aspects. The evolution of chemical processes for production of nuclear grade uranium in various countries is reviewed, and the techniques used at the plant at Le Bouchet are described. The effect of economic considerations on the chemical and engineering problems is outlined. The question of production cost is given special emphasis. (auth)

31121 PREPARATION OF SINGLE-CRYSTAL BORON. Claude P. Talley (Texaco Experiment Inc., Richmond, Va.). J. Appl. Phys., 32: 1787-8(Sept. 1961).

A single crystal of beta-rhombohedral boron approxi-

mately 1.5 mm in diameter and about 1 cm in length was prepared by floating-zone melting with electron bombardment heating under a vacuum. X-ray diffraction transmission photographs revealed both the extent of single-crystal growth and its form. (L.N.N.)

31122 SEARCH FOR NEW BERYLLIUM SOURCES. W. Schweisheimer. Metall., 15: 726-7(July 1961). (In German)

In exploration for Be utilization is made of its γ-induced neutron emission. The most common Be minerals are briefly discussed, and the various applications of the metal are reviewed. (J.S.R.)

31123 IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF BERYLLIUM. Leslie Jack Derham (to National Smelting Co., Ltd.). British Patent 878,390. Sept. 27, 1961.

A process is described for producing beryllium by the reaction of beryllium fluoride with magnesium. In order to prepare the reactants magnesium particles such as raspings are mixed with ammonium beryllium fluoride. The mixture is briquetted, heated in a vacuum to remove ammonium fluoride gas, and subjected to pressure for densification. In the heating step, the briquettes are heated while in contact with a fusible salt (calcium chloride) formed from magnesium fluoride and the beryllium fluoride arises from an excess of the original ammonium beryllium fluoride. (N.W.R.)

Corrosion

31124 (AERE-X/R-320) THE BEHAVIOUR OF ALUMINUM IN LIQUID WATER AT 150–300°C. (British Non-Ferrous Metals Research Assn., London). Jan. 1949. 5p.

Small aluminum specimens of 99.4% purity were exposed to liquid distilled water at temperature from 150 to 300°C and weighed at 48-hr intervals. The oxide film formed at 250°C was examined by x-ray diffraction. The oxide formed at 250°C was found to be $Al_2O_3 \cdot H_2O$. (M.C.G.)

31125 (ASD-TR-61-241) DEVELOPMENT OF A CEMENTATION COATING PROCESS FOR HIGH-TEMPERATURE PROTECTION OF MOLYBDENUM. P. J. Chao, B. S. Payne, Jr., and D. K. Priest (Pfaudler Co., Rochester, N. Y.). June 1961. Contract AF33(616)-7192. 107p.

A pack cementation coating process was successfully developed to protect molybdenum alloy entry vehicle components against oxidation at temperatures near 3000°F. Designated PFR-6, the 2 to 3 mil diffusion coating is a silicide prepared from a siliconizing pack containing small amounts of niobium powder. It was evaluated statistically in an Analysis of Variance study to demonstrate an average lifetime of 1.36 hr in an oxyacetylene torch at a temperature exceeding 3000°F. The 95% confidence limit is 0.71 to 2.01 hr at the same temperature. Three major process concepts were studied: single-cycle codeposition, multicycle codeposition, and multicycle alternate layer coatings. Using these processes 41 types of coatings were made and screened initially, from which 5 were selected for further evaluation. An intensive study of processing and testing variables employing a formal statistical approach resulted in the choice of the single-cycle PFR-6 coating for process optimization. Pack composition, process time, and process temperature were optimized. Recommendations are made for scale-up development of the coating process. (auth)

31126 (CRGM-1030) THE CORROSION RESISTANCE OF Zr–Nb AND Zr–Nb–Sn ALLOYS IN HIGH-TEMPERATURE WATER AND STEAM. PART II. S. B. Dalgaard (Atomic Energy of Canada Ltd., Chalk River, Ont.). July 1961. 43p. (AECL-1308)

The effect of heat treatment, and tin and zirconium purity on the resistance to corrosion and hydrogen pickup of a sponge Zr–2.5 wt % Nb alloy was evaluated. The concentration of niobium in solid solution in alpha zirconium was found to affect the oxidation and hydriding rates, but to a different extent. Ternary addition of tin from 0.5 to 1.5 wt % had an adverse effect on the resistance to corrosion and hydrogen pickup. It was indicated that the impurities inherent in the sponge zirconium had little or no effect on the corrosion and hydriding behavior. (auth)

31127 (HW-68195) A STUDY OF THE WEAR AND GALLING OF AUTOCLAVED ZIRCALOY-2 BY VARIOUS MATERIALS. J. W. Weber (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 1961. Contract AT(45-1)-1350. 57p.

A study was made to find a means of preventing damage to Zircaloy-2 process tubes by supports on fuel elements in pressurized water reactors. Twenty-four metals and alloys, four graphite grades, and four ceramic materials were tested on autoclaved Zircaloy-2 as prospective support materials. Of the materials tested, low-carbon steels appear to be best for application as fuel element supports. (D.L.C.)

31128 (IDO-14554) CORROSION TESTS IN MOLTEN LEAD-LEAD CHLORIDE. N. D. Stolica, G. S. Adams, and M. R. Bomar (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). June 2, 1961. Contract AT(10-1)-205. 20p.

Corrosion tests were run on some commercial grade metals, an alloy steel, stainless steels, chromium–nickel–iron alloys, nickel base alloys, cobalt base alloys, and a chromium–nickel–cobalt–iron alloy in the system: lead-lead chloride-lead chloride vapor at 528°C under an argon atmosphere. The following metals and alloys showed a corrosion rate of nine mils per month or less and did not suffer intergranular or other localized attack: tantalum, Incoloy 804, Hastelloy F, Carpenter-20 (Cb), stainless steels 316L, 318 Cb, Haynes Alloy 25, and Haynes Multimet (auth)

31129 (KAPL-2155) A DISCUSSION OF THE SUSCEPTIBILITY OF AISI 410 TO STRESS CORROSION, AND MEANS OF ELIMINATING THE STRESS-CORROSION PROBLEM. Henry Suss (Knolls Atomic Power Lab., Schenectady, N. Y.). Mar. 10, 1961. Contract W-31-109-Eng-52. 80p.

AISI 410 stainless steel, tempered at 650°F for two hours to Rockwell hardness (Rc) of 36 to 42, is susceptible to stress-corrosion attack in high-temperature, high-purity waters. The time-to-failure is affected significantly by the water chemistry. Metallurgical factors contributing to the stress-corrosion characteristics are reviewed. AISI 410, tempered at 1125°F minimum (Rc 26) and not over 1350°F for four hours minimum, is not susceptible to stress-corrosion failures. Theories are offered that contribute to this immunity. The importance of proper heat-treat practices for maintaining the resistance-to-stress corrosion attack is emphasized. The use of chromium plates for protection of AISI 410 steel against stress-corrosion cracking gave anomalous results. The coating either offered protection under conditions that produced failure in unplated material or caused accelerated failures under conditions that did not produce failure in unplated material. Factors that

may have contributed to the anomalous results are discussed. AISI 410, tempered at 1125°F or higher, showed an increased tendency to pitting attack in oxygenated waters. The extent of the attack is not significant for most applications in pressurized water reactors. Chromium electroplates up to 0.002-in. thick did not offer any significant advantages in minimizing the pitting attack. Because of the anomalous results and other problems associated with chromium electroplates, it was recommended that this deposit not be used for the protection of AISI 410 or equivalent material against general or stress-corrosion attack. Initial studies on the use of gold electroplate for corrosion protection were not encouraging. Nickel deposits (0.002-in. to 0.003-in. minimum) may offer the necessary protection, but additional studies, as recommended, are required. When properly incorporated into a specific production design and effected by a properly designed and controlled process, shot peening will protect hardened (Rc 36 to 42) AISI-410 stainless steel from stress-corrosion failure in high-purity waters at temperatures up to 300°F. This protection will continue for a useful finite period at stresses up to 60,000 psi and indefinitely at stresses up to approximately 45,000 psi, about one-third of the yield strength. Before shot peening can be used for protection against stress-corrosion attack, consideration must be given to the effects of the environment, anticipated stresses, and temperature of application on the fadeout of the surface residual layer. For most applications, establishing adequate process and quality-control procedures should not be a problem. The basic data developed on shot peening of AISI 410 could be made applicable to other susceptible alloys as a means for protection against stress-corrosion attack. (auth)

31130 (NMI-1251) FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. RESEARCH ON THE MECHANISM OF ZIRCONIUM ALLOY CORROSION IN HIGH-TEMPERATURE STEAM. Summary Technical Report to the United States Atomic Energy Commission for the Period July 1, 1960 Through June 30, 1961. Part A. STUDIES ON THE OXYGEN GRADIENT IN CORRODING ZIRCONIUM ALLOYS. J. P. Pemsler. Part B. CRACKING OF THICK OXIDE FILMS ON ZIRCONIUM ALLOYS IN HIGH-TEMPERATURE STEAM. D. S. Kneppel and J. P. Pemsler. Part C. THERMODYNAMICS OF THE INTERACTION OF ZIRCONIUM INTERMETALLICS WITH HYDROGEN AND OXYGEN. A. G. Tobin and J. P. Pemsler (Nuclear Metals, Inc., Concord, Mass.). Oct. 6, 1961. Contract AT(30-1)-1565. 81p.

The oxygen gradient beneath the oxide film on Zr alloys corroding at various temperatures was measured and related to a theoretical expression involving the diffusivity, rate of corrosion and time of corrosion. These data enable accurate quantitative predictions of the oxygen gradient. The mechanism of failure of thick oxide films on corroding Zr alloys was studied at the corrosion temperature by a technique involving decoration of cracks and fissures by HCl. Results indicate that oxide films equivalent in thickness to 500 to 600 mg/dm^2 weight gain formed in steam at 700 to 750°C result in cracks at temperature. Cooling of samples with thick oxide films from temperature and then recorroding at temperature results in accelerated corrosion. Thermodynamic data on the interaction of Zr intermetallic compounds with O and H were obtained. Equilibration with H atmospheres demonstrated that unalloyed Zr is a better getter for H than any of the intermetallic compounds studied. The results of equilibration with O at low activity obtained from an Mg/MgO mixture are inconclusive. (auth)

31131 (TID-13879) ACTIVATION AND TRANSPORT OF LONG-LIVED CORROSION PRODUCTS. Test Evaluation. (Duquesne Light Co., Shippingport, Penna.). [Sept. 1961]. 10p. (DLCS 1980114 and DLCS 1980115)

Tests 14 and 15 were carried out to obtain information on the mechanisms of activation and transport of corrosion products under the reference reactor conditions of high pH. Ten liters of reactor coolant were withdrawn from the purification demineralizer inlet. The sample was filtered through millipore HA paper and radiochemically analyzed for major nuclides. In general, the activity levels decreased in the interval between the 13th and 14th tests and increased between the 14th and 15th. (M.C.G.)

31132 (WADD-TR-60-495) DEVELOPMENT OF CORROSION RESISTANT COATINGS FOR USE AT HIGH TEMPERATURES. William J. Rabin and Harlan P. Tripp (Gulton Industries, Inc., Metuchen, N. J.). Mar. 1961. Contract AF33(616)-6374. 34p.

Details are given of a program to develop corrosion resistant coatings for nickel base alloys and refractory metals. The primary objective was oxidation resistance. The secondary objective was resistance to fuel combustion products at elevated temperatures. The approaches to these problems and the progress are reported. (auth)

31133 (NP-tr-756) THE PROTECTION OF CARBON AND GRAPHITE AGAINST OXIDATION AT TEMPERATURES OF 1200°. M. V. Sazonova, A. Ya. Sitnikova, and A. A. Appen. Translated from Zhur. Priklad. Khim., 34: 505-12(1961). 13p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 18474.

31134 ADSORPTION MEASUREMENTS ON SOLID SURFACES WITH THE HELP OF RADIONUCLIDES. K. Schwabe (Technische Hochschule, Dresden and Zentralinstitut für Kernphysik, Rossendorf, Ger.). Isotopentechnik, 1: 175-8(May 1961). (In German)

Since anion adsorption plays a significant role in corrosion, the investigation of the kinetics of this adsorption has special significance. Labeling with radioisotopes has many advantages for this type of investigation. The individual research techniques used in such studies are described, and their advantages and disadvantages are discussed. (tr-auth)

31135 CORROSION CRACKING OF THE 1Kh18N9T TYPE STAINLESS STEEL. V. V. Gerasimov. Metalloved. i Termichesk. Obrabotka Metal., No. 8, 29-36(Aug. 1961). (In Russian)

Austenitic stainless steels which are known to be subject to stress corrosion cracking were tested in solutions containing chlorides for the purpose of determining the mechanism of crack formation under the influence of deformation and mechanical stresses induced by austenitic transformations. Under usual conditions the metal surface is in a passive state and cracks are formed only on the activated portions. Increase of the Cl^- concentration was found to enhance the crack formation. Sulfate solutions tend to passivate the α-phase; application of stress in sulfate and nitrate solutions does not affect the kinetics of the anodic process and the metal does not show evidence of stress corrosion cracking. Lowering the 0 concentration in the medium, the cathodic process rate is decreased together with the stationary potential, causing a reduction of the dissolution rate of the ferrite and an increase of the resistance of the austenitic phase against corrosion cracking. On the other hand, anodic polarization accelerates the crack formation. In order to avoid the danger of cracking, the highest stresses encount-

ered should not cause austenitic transformations resulting in the formation of the α-phase. (TTT)

31136 PASSIVITY OF CORROSION-RESISTANT ALLOYS IN SOLUTIONS OF CHLORIDES. I. L. Rosenfel'd and V. P. Maksimchuk (Inst. of Physical Chemistry, Academy of Sciences, USSR). Zhur. Fiz. Khim., 35: 1832-8 (Aug. 1961). (In Russian)

A study was made of the passive state stability of corrosion-resistant alloys (Fe–Cr, Ni–Cr, Fe–Cr–Ni, Fe–Cr–Ni–Mo) in NaCl solutions. Chromium is strongly passivated. Anodic polarization of Fe–Cr and Ni–Cr alloys increases with increasing chromium content. Nickel and particularly molybdenum as alloying metals considerably enhance the stability of the passive state of stainless steels in chloride solutions. Quantitative data characterizing the stability of corrosion-resistant alloys in chloride solutions were obtained. (auth)

31137 IMPROVEMENTS IN OR RELATING TO CORROSION INHIBITION OF FERROUS METAL. Geoffrey Winton Horsley, Brian Reginald Thomas Frost, and John Thomas Maskrey (to United Kingdom Atomic Energy Authority). British Patent 878,183. Sept. 27, 1961.

A method is described for inhibiting corrosion of the surface of a ferrous metal plate having a first surface in contact with a molten metal, such as bismuth. The method consists of adding a nitride former (zirconium or titanium to the molten metal to form a nitride layer on the first surface and continuously forming a nitride layer on the second surface of the plate. The metal plate is maintained at 500 to 600°C and ammonia is continuously fed to the second surface. (N.W.R.)

Fabrication

Refer also to abstract 30347

31138 (BMI-1544) PROCESS DEVELOPMENT FOR MAKING SM-1 INSTRUMENTED FUEL PLATES BY GAS-PRESSURE BONDING. Stan J. Paprocki, George W. Cunningham, Charles B. Boyer, and Edward G. Smith, Jr. (Battelle Memorial Inst., Columbus, Ohio). Sept. 18, 1961. Contract W-7405-Eng-92. 24p.

Fabrication of instrumented fuel plate of the SM-1 type designed by Alco Products utilizing the blocked-channel method of plate instrumentation has been developed by use of the gas-pressure-bonding process. Two such instrumented plates will be contained in an instrumented fuel-element assembly and will occupy the same space as three standard fuel plates and two water channels in the SM-1. The plate consists of a low-cross-section Zircaloy-2 filler plate which is contained in a Type 304L stainless steel picture-frame jacket. To prevent any eutectic reaction between the Zircaloy-2 and stainless steel during the bonding cycle, niobium strips 20 mils thick were employed as a barrier. This assembly was covered on top and bottom with SM-1-type fuel plates of one-half standard thickness. Each fuel plate embodies a 3-mil barrier layer of niobium to prevent Zircaloy-iron eutectic formation during bonding. After assembly of the plate components, the composite was evacuated, sealed, and then gas-pressure bonded at 2100°F and 10,000 psi for 3 hr. The as-bonded plate was machined to size and four thermocouple holes were drilled. (auth)

31139 (BMI-1545) PRELIMINARY STUDIES OF BONDING OF BERYLLIUM-CLAD UO_2 FUEL ELEMENTS. Stan J. Paprocki, Edwin S. Hodge, and James S. Perrin (Battelle Memorial Inst., Columbus, Ohio). Sept. 20, 1961. Contract W-7405-eng-92. 20p.

Gas-pressure bonding was investigated as a fabrication technique for the solid-state bonding of beryllium. Bonding parameters, surface-preparation methods, and compatibility of beryllium with UO_2 and with several container and barrier materials were studied. Beryllium-to-beryllium bonds were obtained after 2 to 4 hr at 1550 to 1650°F at 10,000 psi. Bonds produced with grit-blasted and abraded specimens exhibited recrystallization of grains at the original interface. The interface did not appear weaker than the parent metal during limited mechanical testing. Chromium or pyrolytic carbon coatings on UO_2 cores prevented significant UO_2-beryllium reactions during bonding for 4 hr at 1650°F and 10,000 psi. Reaction products formed on the beryllium surface during compatibility experiments with other materials were easily removed by acid pickling. (auth)

31140 (CRCE-716(Pt.IV)) PREPARATION OF URANIUM DIOXIDE FOR USE IN CERAMIC FUELS. PART IV: STUDIES OF MICRONIZED URANIUM TRIOXIDE. W. T. Bourns and L. C. Watson (Atomic Energy of Canada Ltd., Chalk River, Ont.). Mar. 1960. 16p. (CEI-111; AECL-1311)

The possibility of using UO_2 made by hydrogen reduction of micronized UO_3 to make pressed and sintered UO_2 fuel was investigated briefly. Pot denitrated UO_3, when reduced, pressed and sintered, yielded UO_2 pellets of density 8.7 and 9.5 g/cm^3. Micronized UO_3 treated in the same way yielded pellets of density as high as 10.6 g/cm^3. The densities obtained varied little for wide variations in the feed rate to the eight inch diameter Micronizer. However there was variation between samples micronized under nominally the same conditions. (auth)

31141 (DMIC-Memo-125) REVIEW OF RECENT DEVELOPMENTS IN METALS JOINING. J. J. Vagi, W. J. Lepkowski, H. W. Mishler, and H. E. Pattee (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Sept. 1, 1961. 7p.

A summary is presented of major developments in the technology of metals joining. Information received at DMIC during the period Apr. 30 to July 20, 1961, is covered. (auth)

31142 (FD-51) THE ASSEMBLY AND TESTING OF EXPERIMENTAL FUEL ELEMENTS FOR IRRADIATION TESTING. M. B. Watson (Atomic Energy of Canada Ltd., Chalk River, Ont.). Apr. 1961. 32p. (AECL-1288).

Details are given of fabrication techniques employed in the preparation of experimental fuel elements for irradiation testing. (auth)

31143 (HW-68835) ANNEALING WARM-EXTRUDED ZIRCALOY-2 TO AN ULTRAFINE GRAIN SIZE. R. L. Knecht (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 1961. Contract AT (45-1)-1350. 16p.

Zircaloy-2 was warm extruded twice with an intermediate vacuum anneal. It was then heat treated in a salt bath for various time spans at temperatures of 1100, 1200, and 1300°F. Recrystallization and softening of this heavily worked metal were complete after 16 minutes at 1100°F, 4 minutes at 1200°F, and 1 minute at 1300°F. Ultrafine grains with an average diameter of about six microns were produced by annealing in the salt bath for 16 minutes at 1100°F; larger grains were produced with the longer times and higher temperatures. Vacuum annealing produced slightly larger grains than salt annealing, probably because of a slower heating rate. The extensive cold working of the metal is apparently the major factor in producing the fine grains. It was concluded that an average grain diameter of six microns or smaller can be produced with the following

conditions: a highly cold-worked structure, such as that provided by warm extruding twice (10 : 1 extrusion ratio) with an intermediate low temperature anneal; a short annealing time at a low-annealing temperature, such as 16 minutes at 1100°F; and a rapid heating to the annealing temperature, similar to that afforded by the salt bath. Other work on salt bath annealing at Hanford showed no significant hydrogen contamination of the Zircaloy, nor was the corrosion resistance of the metal to water or steam affected by salt bath annealing for the cycles recommended above. (auth)

31144 (HW-70950) HANFORD STUDIES EXECUTED FOR THE USAEC-AECL COOPERATIVE PROGRAM ON DEVELOPMENT OF HEAVY WATER MODERATED POWER REACTORS. Monthly Progress Report, August 1961. J. M. Batch, R. S. Paul, and L. E. Mills (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.) Sept. 6, 1961. 3p.

Progress is reported on: fabrication of electrically heated test sections for boiling burnout experiments; design and fabrication of an ultrasonic tester for fuel-sheath tubing; and a magnetic force-welding method for closure welds on sintered-Al-powder fuel cladding. (T.F.H.)

31145 (LA-2572) FABRICATION OF TANTALUM ROD. E. L. Brundige (Los Alamos Scientific Lab., N. Mex.). Mar. 1961. Contract W-7405-Eng-36. 35p.

Electron-beam-melted and arc-cast billets of Ta and Ta–0.1 w/o W alloy can be reduced to rod by direct extrusion or by rolling. Rolling produces a more uniform surface and more sound material with a corresponding greater yield. (auth)

31146 (NAA-SR-6436) EFFECT OF PRESSURE AND TEMPERATURE ON THE END POINT DENSITY OF ALUMINA. J. D. McClelland and E. H. Zehms (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Sept. 30, 1961. Contract AT(11-1)-GEN-8. 17p.

The effect of pressure and temperature on the hot pressing of aluminum oxide was studied. Temperatures ranged from 1100 to 1500°C, and pressures from 500 to 6000 psi. An asymptotic end point density was found to exist which is dependent only on the final pressure and temperature. The pressure dependence of the end point density can be explained in terms of a plastic flow model. The temperature dependence suggests a thermally activated process is operative whose activation energy is 20 kcal. The distribution of porosity during hot pressing suggests that hot pressing is effective in total removal of grain boundary porosity. (auth)

31147 (NP-10736) A STUDY OF EXPLOSIVE FORMING SELECTED REFRACTORY METALS. Progress Report No. 2, July 1, 1961–August 31, 1961. (Chromalloy Corp. Propellex Chemical Div., Edwardsville, Ill.). Sept. 15, 1961. Contract NOw-61-0832-c. 29p.

Progress in the investigation of the explosive forming of selected refractory metals is reported. Modifications to both the uni-directional trough die and the multi-directional cup die were completed. The draw ring pressure was optimized. For all experimental firings, photo-resist grids were placed on each metal blank. Etching of the Mo–½ Ti and Nb was optimized. The solution chosen consisted of 45% HNO_3 and 55% H_2O. A general heat transfer analysis was derived that can be used in conjunction with the problem of thermal detonation. A study was carried out on transfer media. Powdered alumina appeared to be the most feasible. (M.C.G.)

31148 (NP-10761) THE MANUFACTURE OF Ti–7Al–12Zr SHEETS. Bi-Monthly Report XII, June 30, 1961–August 31, 1961. J. K. Dietzel and S. R. Seagle (Reactive Metals, Inc., Niles, Ohio). Sept. 1961. Contract NOa(s) 59-6229-c. 6p.

31149 (ORO-476) SYNTHESIS AND FABRICATION OF REFRACTORY URANIUM COMPOUNDS. Monthly Progress Report No. 4, July 1 through July 31, 1961. K. M. Taylor and C. H. McMurtry (Carborundum Co. Research and Development Div., Niagara Falls, N. Y.). Aug. 8, 1961. Contract AT(40-1)-2558. 3p.

Results are reported from an investigation of the effects of certain impurities and porosity on the irradiation behavior of high density U monocarbide pellets made by cold pressing and sintering. Data are included on the effect of Ni additions on sintered density and the effect of sintering temperature on density. The fabrication of 10% enriched UC pellets for use in irradiation studies is in progress. (C.H.)

31150 (AEC-tr-4464) THE DESIGN OF SPECIAL HOODS FOR MACHINING NATURAL URANIUM METAL. STUDIES ON URANIUM FUEL ELEMENT. PART IV. Kiyoaki Taketani. Translated from J. At. Energy Soc. Japan, 1: 370-5(1959). 15p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 7747.

31151 (AEC-tr-4811) THE POSSIBILITY OF PRODUCING A METALLURGICAL BOND BETWEEN STAINLESS STEEL AND ZIRCALOY-2. A. Bassi, E. Brutto, C. Corsetti, and G. Perona. Translated for Westinghouse Electric Corp., Bettis Atomic Power Lab., Pittsburgh from Met. ital., 51: 509-14(1959). 9p.

Methods of joining steel and Zircaloy-2 tubing and the requirements of the joint are discussed. Studies were focused on diffusion welding in the solid phase. A search indicated that very few metals have good diffusion characteristics with respect to both Zircaloy and steel. Therefore the number of metals to be interposed was extended to two. Tests were carried out on diffusion couples including steel–Zircaloy, steel–Ni, Cu–Ni, Ag–Zircaloy, and Zircaloy–Cu. In the preliminary studies, the joint which possessed the best characteristics, resistance to corrosion included, was the one obtained directly, by diffusion in the solid phase, between steel and Zircaloy at temperatures lower than 1050°C. The effects of time and pressure on the quality of the bend were not demonstrated. (M.C.G.)

31152 (NP-tr-757) WELDING OF TITANIUM AND ITS ALLOYS. A translation of "Svarka Titana i Ego Splavov." M. Kh. Shorshorov and G. V. Nazarov—G. B. Evseev (Yevseyev), ed. Translated from a publication of the State Publishing House of Scientific-Technical Literature on Heavy Machine Construction, Moscow, 1959. 179p.

The basic properties and methods of producing titanium and its alloys are discussed. The effects of composition of alloys and harmful impurities on weldability were determined. Features of heat processes during welding were examined as well as the control of structure and properties of welded joints and the principles of choosing the conditions of welding and heat treatment. Arc welding in inert gases and under flux, electric slag welding, resistance welding, and soldering are described. Basic areas of the use of welded constructions are discussed. (auth)

31153 (UCRL-Trans-719(L)) HOMOGENEOUS AND HETEROGENEOUS EVAPORATED ANTIMONY FILMS. E. Ruedl. Translated by G. A. Condas (Univ. of California Lawrence Radiation Lab., Livermore) from Vacuum, 7-8:

56-60(1957-58) (Pub. Apr. 1959). 12p. (Includes original, 5p.).

Structures of antimony deposits produced by vacuum evaporation were investigated. Experiments using different evaporation speeds producing deposits of a thickness ranging from 0 to 2000A were conducted to study the crystallization mechanism in heterogeneous films. (auth)

31154 MACHINING THE ASTRO-METAL-PURE BERYLLIUM. Laurence W. Collins, Jr. ed. Machinery (N. Y.), 67: No. 10, 93-7(June 1961).

Speeds, feeds, and chip loads in machining beryllium resemble those used in processing cast iron. Cast ingots are coarse-grained, with directional characteristics, and thus not suitable for further fabrication into gyro gimbals and similar rocket parts. Material to be machined is made from beryllium powder obtained by hot press powder techniques or from compacted ingot chips. Great care is taken to prevent heating to temperatures high enough to cause formation of beryllium oxide. Vacuum ducts are utilized over each machining operation to save the dust and chips due to the high cost of the metal. No coolant is used in any machining in order to avoid contamination of the chips. (N.W.R.)

31155 A MACHINE SHOP BEHIND OUR ATOMIC SUBMARINES. Harold W. Bredin, ed. Machinery (N. Y.), 67: No. 10, 98-105(June 1961).

A general discussion is presented on the machining of unique and contoured parts for nuclear submarines. Included in this discussion is the training program used, equipment used for unusual and large parts, and the techniques used in these machining operations. Illustrations are presented of the parts machined with the equipment used. Equipment includes numerically controlled drilling machines, engine lathe, modified horizontal honing machine, jigless drilling machine, 16-foot planer-mill, and a large boring and milling machine. (N.W.R.)

31156 METALLIC BONDING BETWEEN URANIUM AND ALUMINUM FOR REACTOR FUEL ELEMENTS. G. Schneider. Metall, 15: 675-9(July 1961). (In German)

Because of the possibility of a metallic compound between uranium and aluminum, an old soldering method was discussed in which an Al–13% Si alloy was used. The advantages of this method lead to the development of a Zn/Sn weld which is especially suitable for fuel elements for water-cooled reactors. Its improvement by a tested soldering method was described. If one goes to a coolant which is compatible with Al surfaces above 230°C the application of diffusion bonding with nickel is recommended. The properties and improvements of this metallic bonding was reported. Its limited application to temperatures between 350 and 400°C can be expanded by improvement of the diffusion impeding layer to temperatures from 450 to 500°C, which is also connected to a simplification of the soldering method. (tr-auth)

31157 PREPARATION OF TARGETS FROM READILY OXIDIZING MATERIALS. V. Ya. Golovnya and V. P. Moldovanov (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Pribory i Tekh. Ekspt., 6: No. 3, 185-6(May-June 1961). (In Russian)

An installation for depositing 0.05 μ-thick targets on an organic surface by sublimation in a vacuum is described. Targets of 0.1 to 3.0 μ of Ca withstood a proton flux of 0.01 μamp for 20 hours, and Na target of identical thickness withstood a flux of 0.003 μamp for 5 hours. The targets were irradiated with 1.5 to 3.0 Mev protons. (R.V.J.)

31158 PREPARATION OF METAL TARGETS OF Yb, Eu, AND Sm FROM OXIDES. A. D. Bondar, V. N. Karev, and A. P. Klyucharev (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Pribory i Tekh. Ekspt., 6: No. 3, 186-7(May-June 1961). (In Russian)

Thin Yb, Eu, and Sm targets were prepared by reduction with La in a vacuum. Reduction of Eu and Yb is achieved at 1100 to 1200°C and Sm at ~1400°C. Condensed Eu and Yb produce ductile films while the Sm film is friable. (R.V.J.)

31159 FUNDAMENTAL PRINCIPLES OF POWDER METALLURGY. W. D. Jones. London, Edward Arnold (Publishers) Ltd., 1960. 1044p.

The fundamental principles of powder metallurgy are discussed and explained. Both theoretical and practical principles are involved in detailed discussions covering such topics as preparation, pressing, sintering, shaping without pressing, attainment of specific qualities, continuous powder metallurgy techniques, and control methods. (N.W.R.)

31160 IMPROVEMENTS IN OR RELATING TO PRESSURE WELDING OF METALS. Jack Williams and William Munro (to United Kingdom Atomic Energy Authority). British Patent 877,580. Sept. 13, 1961.

A method for pressure-welding metals is described which uses a deformable material to transmit the pressure and thus result in a more uniform weld. The method is particularly suited to the pressure-welding of a beryllium tube to a beryllium end plug, using mild steel at 750 to 850°C as the deformable material. (D.L.C.)

31161 IMPROVEMENTS IN OR RELATING TO MOULDS FOR HOT PRESSING POWDERED MATERIALS. John Sidney O'Neill and David Thomas Livey (to United Kingdom Atomic Energy Authority). British Patent 878,088. Sept. 27, 1961.

Descriptions are given of a molding process and graphite molds for hot pressing powdered refractory material (beryllium oxides) into dense tubes. The core consists of a hollow graphite shell of thickness such that it will withstand the hot pressing operation (1400 to 1800°C), but crushes (subsides) under the contractional load on cooling. Graphite core sizes are given for beryllium oxide tubes of length 1 to $1\frac{1}{2}$ inches and $\frac{1}{3}$ to 1 inch ID. (N.W.R.)

31162 METHOD OF FORMING TANTALUM SILICIDE ON TANTALUM SURFACES. Melvin G. Bowman and Nerses H. Krikorian (to U. S. Atomic Energy Commission). U. S. Patent 3,002,852. Oct. 3, 1961.

A method is described for forming a non-corrosive silicide coating on tantalum. The coating is made through the heating of trirhenium silicides in contact with the tantalum object to approximately 1400°C at which temperature trirhenium silicide decomposes into rhenium and gaseous silicons. The silicon vapor reacts with the tantalum surface to form a tantalum silicide layer approximately 10 microns thick. (AEC)

31163 WELDING TORCH. Thomas B. Correy (to U. S. Atomic Energy Commission). U. S. Patent 3,003,050. Oct. 3, 1961.

A welding torch into which water and inert gas are piped separately for cooling and for providing a suitable gaseous atmosphere is described. A welding electrode is clamped in the torch by a removable collet sleeve and a removable collet head. Replacement of the sleeve and head with larger or smaller sleeve and head permits a larger or smaller welding electrode to be substituted on the torch. (AEC)

31164 METHOD AND APPARATUS FOR EFFECTING THERMAL BONDS. Harry O. Monson and Robert A. Jaross (to U. S. Atomic Energy Commission). U. S. Patent 3,005,079. Oct. 17, 1961.

A device is described for completing the alkali metal bond between a fuel element and its jacket. It consists of a heater and electromagnet surrounding the fuel element so that while it is heated a rotating magnetic field will agitate the alkali metal and work out void spaces. (AEC)

Properties and Structure

Refer also to abstract 30346

31165 (AD-256900) DIELECTRICS FOR SATELLITES AND SPACE VEHICLES. Interim Report No. 2, May 1, 1960–February 28, 1961. Louis J. Frisco (Johns Hopkins Univ., Baltimore. Dielectrics Lab.). Mar. 15, 1961. Contract DA-36-039-SC-78321. 79p.

Results of the second phase of a study of the effects of simulated high altitude environment on the electrical properties of insulating materials are reported. High vacuum breakdown and flashover measurements in the 10^{-6} mmHg range at d-c, 60-cps, 2-Mc and 18-Mc indicated that electrode surface roughness is the controlling factor. Dielectric properties of the specimen material did not influence flashover voltage. X rays and ultraviolet radiation had no effect on flashover voltage. Significant changes in low-frequency loss properties and d-c conductivity were observed during and after vacuum irradiation with 50-kv x rays. Ultraviolet radiation produced no immediate effects on loss properties. (auth)

31166 (AERE/EMR/PR-1084/1) BINARY CARBIDE–METAL SYSTEMS. Progress Report No. 1. (Sheffield, England. Univ.). [nd.]. Agreement No. 13/5/165/1084. 3p.

A high-temperature, high-vacuum furnace was designed and constructed for studies of UC–metal systems. Oxidation of powdered UC in air at room temperature was found to amount to 1.1 mole % in 18 hr. Weight changes of powdered UC samples heated under vacuum are reported. A UC–15.5% Ni mixture was found to lose Ni upon heating for 2 hr at 1660°C in vacuum. (D.L.C.)

31167 (AERE/EMR/PR-1084/2) BINARY CARBIDE–METAL SYSTEMS. Progress Report No. 2. (Sheffield, England. Univ.). [nd.]. Agreement No. 13/5/165/1084. 8p.

UC–Ni mixtures were fired at 1300 to 1600°C and examined to identify the phases formed. Some of the phases found were C, UC, UC_2, UNi_5, and Ni. A tentative U–Ni–C ternary phase diagram is presented. Similar phase studies were carried out on UC–Fe and UC–Cr mixtures. (D.L.C.)

31168 (AERE/EMR/PR-1084/4) BINARY CARBIDE–METAL SYSTEMS. Progress Report No. 4. (Sheffield, England. Univ.). [nd.]. Agreement No. 13/5/165/1084. 7p.

No reaction or solid solutions were observed between UC and Cu in fired mixtures, and a qualitative phase diagram with a binary eutectic very near to the Cu end is presented. The U–C–Co system was investigated by x-ray and metallographic examination of fired UC–Co mixtures, and a tentative solid-state ternary diagram is presented. The UC–UFe_2 system was found to form a binary eutectic system with no appreciable solid solubility, and the eutectic composition and melting point were determined. (D.L.C.)

31169 (AERE/EMR/PR-1084/5) BINARY CARBIDE–METAL SYSTEMS. Progress Report No. 5. (Sheffield, England. Univ.). [nd.]. Agreement No. 13/5/165/1084. 4p.

UC–C–Fe mixtures were fired for study of the UC_2–Fe system, and metallographic evidence were obtained for a ternary compound with the probable composition of UC_2Fe. The eutectic between UC_2Fe and Fe was observed to lie between 60 and 62 wt % Fe. Metallographic examination of fired UC_2–Cr mixtures indicate that UC_2–Cr is not a tie line in the U–Cr–C system. Two methods of preparing UN are described. Studies of fired UN–Fe mixtures revealed a eutectic occurring at 48.5 ± 0.5% Fe and having a melting point between 1400 and 1450°C. (D.L.C.)

31170 (ANL-6116) STRUCTURES AND PROPERTIES OF URANIUM–FISSIUM ALLOYS. Final Report–Metallurgy Program 4.1.23. S. T. Zegler and M. V. Nevitt (Argonne National Lab., Ill.). July 1961. Contract W-31-109-eng-38. 51p.

A study was made of the phase relations and the properties of uranium–fissium alloys which have compositions bracketing that intended for the first core loading of Experimental Breeder Reactor II. The fissium aggregate in the alloys consisted of the elements Zr, Nb, Mo, Ru, Rh, and Pd. Phase relations are shown to parallel closely those in the dominant U–Mo–Ru ternary system. The uranium gamma phase is stabilized down to 552°C, while the beta phase is entirely suppressed at high fissium contents. Certain crystallographic data are given and the minor phases that occur in the alloys are identified. In cast and gamma-quenched alloys the retention of the high-temperature gamma phase produced low hardness and low density. The thermal expansion behavior of the alloys is shown to be dependent upon composition and prior thermal history. Thermal conductivity data are presented for uranium and the uranium–fissium alloys. The thermal conductivities of the alloys decrease with increasing fissium concentration. (auth)

31171 (ARF-2981-4) LOW-TEMPERATURE DISINTEGRATION OF INTERMETALLIC COMPOUNDS. Final Report, December 1, 1960–August 31, 1961. John J. Rausch and Charles R. Simcoe (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Aug. 31, 1961. 28p.

The abnormal disintegration which occurs in intermetallic compounds when oxidized at relatively low temperatures was studied. This disintegration reaction occurs at temperatures well below those at which the compounds normally display excellent resistance to oxidation. The characteristics of the reaction were studied in $NbAl_3$ and $MoSi_2$, the two compounds in which it was previously known to occur. In addition, the occurrence of the reaction was studied in oxidation-resistant compounds not previously investigated. (auth)

31172 (BMI-1050(Del.)) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING OCTOBER 1955. Russell W. Dayton and Clyde R. Tipton, Jr. (Battelle Memorial Inst., Columbus, Ohio). Nov. 1, 1955. Decl. with deletions Jan. 29, 1960. Contract W-7405-eng-92. 75p.

Progress is reported on development of PWR fuel materials and fuel elements, development of materials for reactors, fuel element development, plant assistance to Mallinckrodt Chemical Works, processing of feed materials, ceramic fuel element development, metallurgy, studies of fuel element corrosion, studies of Zr–U alloys, corrosion studies of Zr, reactor materials development, and physical metallurgy. (M.C.G.)

31173 (CEND-140) THE DEVELOPMENT AND TESTING OF HOMOGENEOUS CERAMIC FUELS. Quarterly

Report, March 1, 1961–May 31, 1961. G. Zuromsky and W. P. Chernock (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). June 1961. Contract AT(30-1)-2379. 33p. (NYO-2995)

In investigations on phase relations of UO_2-ZrO_2-CaO and UO_2-CeO_2 systems, the emphasis during the report period was on aspects of hydrogen sintering and the effects of this method on composition limits for the single-phase face-centered cubic region. Argon sintering evaluations were also made. Results indicate that 1800°C is required for production of single-phase solid solutions. In thermal shock resistance studies, vapor-deposited W metal on the inner surface of pellets did not react with ZrO_2 at 2000°C, however cracks developed at 800 to 1000°C. Corrosion tests of CaO stabilized ZrO_2 containing UO_2 in water are being conducted, and methods for determining UO_2 content in fuel samples are being developed. (J.R.D.)

31174 (CRGM-1017) SOME CREEP PROPERTIES OF ZIRCALOY-2. L. G. Bell (Atomic Energy of Canada Ltd., Chalk River, Ont.). June 1961. 48p. (AECL-1305)

The strain-age-hardening processes that occur in Zircaloy-2 in creep were studied, particularly their effect on the creep strength. The creep strength of annealed and cold-worked Zircaloy-2 was found to be much the same as that observed by other workers, and there is no indication that the material is unsafe up to conditions of 20,000 psi at 300°C for the annealed and 24,000 psi at 300°C for the 13.1% cold-worked alloy. There is a rapid decrease in creep strength above 300°C for both materials, and this is probably their most serious limitation. Jogs which occasionally appear in creep curves for Zircaloy-2 at low stress contribute a small amount to the strain, but once they are over, the material exhibits normal creep behavior. During the early stages of creep, annealed Zircaloy-2 has an unexpectedly high creep resistance at temperatures between 250° and 400°C. This is thought to be caused by a pre-load strengthening. At temperatures below 250°C primary deformation is high because the strengthening mechanism does not operate. Zircaloy-2 undergoes three strain-age-hardening reactors. Strengthening of the material by cold work allows time for the reactions to occur and results in a much higher creep resistance during the early stages of creep. In cold-worked Zircaloy-2 at 300°C when the creep stresses are above 40,000 psi, there is a marked decrease in the strain at which tertiary creep begins and also a loss of ductility. Enlarging the grain size of annealed Zircaloy-2 changes the shape of the curve, increasing primary strain, but it does not impair the creep strength. (auth)

31175 (DMIC-Memo-128) REVIEW OF RECENT DEVELOPMENTS IN THE EVALUATION OF SPECIAL METAL PROPERTIES. J. E. Campbell (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Sept. 27, 1961. 10p.

A review is presented of recent developments in studies of: the effects of interstitial oxygen on the tensile strengths of Al–Sn–Ti, and Al–Ti–V alloys at 78 to −423°F; the effects of cracks on the tensile strengths of Al–Cr–Ti–V, and Al–Ti–V alloys; and the determination of hydrogen embrittlement of cadmium-plated metals. (B.O.G.)

31176 (GA-2548) INVESTIGATIONS OF CARBIDES AS CATHODES FOR THERMIONIC SPACE REACTORS. Quarterly Progress Report, Period Ending August 31, 1961. A. F. Weinberg, R. G. Hudson, B. Siefner, and L. Yang (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Contract NAS 5-1253. 48p.

The physico-chemical properties of mixed carbides of uranium and zirconium were measured to 2400°K. Vapor-loss measurements are being conducted to determine the influence of the U: Zr ratio. Thermal aging of 90 mol % UC–10 mol % ZrC in a vacuum at 2300°K lowered the surface uranium concentration to about 35 mol % UC, and thereby lowered its vaporization loss. Specimens of 10 to 20 mol % UC maintained a constant concentration of uranium on their surfaces during thermal aging at 2300°K, but did show a decrease in weight loss with increasing exposure times. The specimens of low UC content showed rates of weight loss at 2300°K at least an order of magnitude lower than the rate exhibited by the high-UC specimen. Analyses of collected condensate have been performed. Electrical-resistivity measurements have been conducted for mixed-carbide specimens from room temperature to 2400°K. The resistivity data obtained are represented as a linear function of temperature. The interdiffusion between UC and tantalum or niobium is being investigated using a technique which incorporates the bonding of the diffusion couple as an integral part of the diffusion anneal. A UC-Nb diffusion couple annealed at 1875 ± 20°C for 5 min and a UC–Ta diffusion couple annealed at 1925 ± 30°C for 90 min both showed evidence of entry into a three-phase region composed of UC + liquid + (U,Nb) or (U,Ta) solid solution. Evidence of the Kirkendall effect has been found, and voids were observed which may be associated either with this effect or with a volume change during solidification of the liquid phase. (auth)

31177 (GAMD-798) THE FORMATION AND PROPERTIES OF PYROLYTIC CARBON. G. L. Allen (General Atomic Div., General Dynamics Corp., San Diego, Calif.). May 19, 1959. Contract AT(04-3)-314. 11p.

Pyrolytic carbon is a carbon form produced on a hot surface by the decomposition of a hydrocarbon gas. Its properties are primarily temperature dependent with secondary dependence on the partial pressure of the hydrocarbon gas. The type of hydrocarbon has little effect on the type or form of pyrolytic carbon produced but can effect rate of deposition and tendency to form soot. The basic mechanism of formation is unsolved. (auth)

31178 (GAMD-2412) IMPERMEABLE GRAPHITE EVALUATION PROCEDURE USED AT GENERAL ATOMIC. B. F. Disselhorst and W. L. Wyman (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Aug. 1, 1961. Contract AT(04-3)-314. 29p.

The procedures for evaluating impermeable graphites are given. The form of recording the data is also included. Specifications for HTGR graphite including chemical composition, permeability, thermal conductivity, coefficient of thermal expansion, and mechanical properties are discussed. Methods of determining density, permeability, coefficient of thermal expansion, thermal conductivity, and mechanical and chemical properties are outlined. (M.C.G.)

31179 (HW-33821(Del.)) EVALUATION OF URANIUM–SILICON ALLOY. M. A. Ryan (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 28, 1954. Decl. with deletions Jan. 20, 1960. Contract W-31-109-eng-52. 14p.

A fuel element resistant to core failure at high HAPO irradiation exposure levels was desired and an alloy fuel element which might meet this requirement was studied. The uranium –1.5 at % silicon alloy was selected as it does not quench crack during heat treatment, can be fabricated under production conditions, and has a low reactivity loss. Alpha rolling and beta heat treatment of the cast alloy was successful using the present FMPC production schedule for natural uranium although it was successfully rolled in the

laboratory. Alpha extrusion of the coreduced derby uranium–silicon alloy under production conditions was successful, and the heat treated extruded alloy possessed excellent mechanical properties and a fine grained randomly oriented structure. Development work is being done on this alloy in preparation for a proposed pile test. (auth)

31180 (IS-221) ROLES OF NIOBIUM PENTOXIDE, VANADIUM PENTOXIDE AND TITANIUM DIOXIDE IN THE GRAIN GROWTH AND SINTERING OF URANIUM DIOXIDE. James Frederick Watson and D. R. Wilder (Ames Lab., Ames, Iowa). May 1960. 89p.

An addition of 0.1% V_2O_5 to UO_2 promotes sintering below 1500°C by forming an interstitial solid solution at the particle surfaces, thus prompting increased surface diffusion activity during the early stages of densification. However, the solution melts as the temperature is increased and densification is inhibited until the melt has decomposed and volatilized out of the system. Densification and grain growth then progress by the mechanisms observed in pure UO_2. Titanium dioxide acts as an oxygen supplier during the early stages of sintering, increasing densification significantly by promoting non-stoichiometric oxygen diffusion. At higher temperatures a ductile solid solution or liquid phase is formed that aids sintering and grain growth by straining the lattice near the grain surface, permitting diffusion of stoichiometric UO_2. An addition of 0.4% Nb_2O_5 to UO_2 aids densification at temperatures below 1500°C by forming an interstitial solid solution or defective surface structure. The Nb_2O_5 additive melts and decomposes above 1500°C maintaining open porosity and thus preventing grain growth until decomposition is complete and the open pores have closed. (auth)

31181 (KAPL-2162) INVESTIGATIONS OF BINARY ZIRCONIUM ALLOYS. A. E. Bibb, A. P. Beard, and D. L. Douglass (Knolls Atomic Power Lab., Schenectady, N. Y.). Nov. 1, 1960. Contract W-31-109-Eng-52. 24p.

The effects of alloy additions on the mechanical properties and corrosion resistance of crystal bar zirconium were studied. Both electronic contribution and lattice strains associated with alloy additions affected the corrosion rate of zirconium. Solid-solution strengthening was possible in zirconium but the most strengthening was obtained in two-phase alloys. The two-phase alloys generally exhibited poor corrosion resistance in 680°F water and 750°F steam. (auth)

31182 (MLM-1115) MOUND LABORATORY MONTHLY PROGRESS REPORT FOR MAY 1961 [ON PLASTICS, RADIOELEMENTS, ISOTOPE SEPARATION, AND REACTOR FUELS]. J. F. Eichelberger (Mound Lab., Miamisburg, Ohio). May 30, 1961. Contract AT-33-1-GEN-53. 18p.

Formulation of 13 new epoxy-modified polyurethane systems were cast and cured. Results of chemical tests on an epoxy curing exudate are included. Comparison of solvent effects on retention of radioelements by stainless steel was started and data are tabulated for Ac^{227}, Th^{227}, and Ra^{223}. Work on protactinium was resumed after suspension of this project in 1960. Methods for preparation of small quantities of highly enriched U isotopes are being examined. Included in the survey are chemical exchange, electromagnetic separation, gaseous and liquid thermal diffusion, gas centrifugation, and photochemical techniques. Continued investigation of viscosities of La and Pr for use in Pu alloys is reported. Phase studies of Au–Pt systems were continued along with studies of Pu bearing glass fibers. (J.R.D.)

31183 (NAA-SR-4245(Del.)) DISSOCIATION PRESSURES OF HYDRIDED ZIRCONIUM–URANIUM ALLOYS. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 25, 1960. Decl. with deletions Sept. 29, 1960. 25p.

Pressure-temperature isochores were obtained for zirconium-hydrogen alloys, 93 wt % Zr–7 wt % U hydride alloys, and 90 wt % Zr–10 wt % U hydride alloys. Hydrogen compositions of these alloys ranged from 45 at % to 66 at %. The studies were conducted between 1200 and 1500°F. Comparison of the pressure-composition-temperature results of the three alloys showed that the uranium is in an inert phase with respect to the dissociation pressures of the alloys. The dissociation pressure can be expressed simply as a function of temperature and H/Zr, i.e., atomic ratio. The enthalpy values for four phase regions of the zirconium-hydrogen system were obtained from the dissociation pressure data. Equations were also derived to express the dissociation pressure-composition-temperature relationships of these four regions. (auth)

31184 (NAA-SR-5925) MOLTEN PHOSPHATE REACTOR FUEL. PART I. W. S. Ginell (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Sept. 30, 1961. Contract AT(11-1)-GEN-8. 39p.

An initial survey was made of some of the important problems associated with the use of molten phosphates as nuclear reactor fuels. The temperature dependence of the viscosity of molten sodium polyphosphate (Na/P = 1.12) was determined. The viscosity-reducing effect of sulfates and other ions was interpreted on the basis of melt structure. Solubility measurements of uranium and thorium compounds indicated that maximum solubilities were obtained with U (VI) compounds and with thorium orthophosphate. Static, isothermal corrosion rates of a number of metals and alloys were determined. At 700°C, the initial corrosion rate of Fe–Ni–Cr alloys was a function of the iron content; Ni–Cr–Mo alloys exhibited low rates; and Mo, W, V, Pt, and Au were inert. Phosphide films formed on metal surfaces in situ were found to reduce initial rates. Heat transfer calculations for a sodium-cooled, in-line tube bank heat exchanger indicated that only a moderately sized unit would be required for a 100-Mw system. Reactor calculations were made to determine the dependence of some nuclear parameters on fuel composition. The fission energy spectrum for uranium systems was in the epithermal region, while plutonium yielded a fast spectrum. Designs for a shielded, rotating crucible molten salt viscometer and a molten salt thermal conductivity apparatus are given. (auth)

31185 (NAA-SR-6428) DECREPITATION OF BERYLLIUM OXIDE AT HIGH TEMPERATURE. S. B. Austerman (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Sept. 30, 1961. Contract AT(11-1)-GEN-8. 11p.

Changes in physical and geometrical appearance and in microstructure are described. An order-disorder phenomenon coupled with dislocation rearrangement is suggested as the mechanism of decrepitation. (auth)

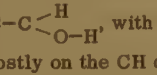
31186 (NAA-SR-6483) TRANSIENT CREEP AND ASSOCIATED GRAIN-BOUNDARY PHENOMENA IN POLYCRYSTALLINE ALUMINA AND BERYLLIA. R. Chang and L. J. Graham (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Sept. 30, 1961. Contract AT(11-1)-GEN-8. 44p.

The importance of, and the interrelation between, transient creep and grain-boundary phenomena in polycrystalline alumina and beryllia are discussed. It is found that the transient creep strain in these materials follows the

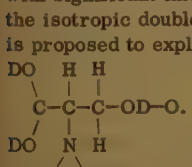
relationship $\epsilon \cong \alpha(t/\tau)^m$, where α is a constant dependent on the applied stress, t is time, τ is a time constant related to temperature by the Arrhenius equation $\tau = \tau_0[\exp(Q/RT)]$, and m is an exponent of the order of $^2/_3$ to $^1/_3$. Except for the initial stage of transient creep, m varies usually between 0.3 and 0.4 and Q is an activation energy almost equal to that for self-diffusion. During the initial stage of transient creep, m is considerably larger and the activation energy Q considerably smaller. A new mechanism, combining grain-boundary motion and diffusion-controlled stress relaxation along grain boundaries and at grain corners, is proposed to explain the difference in tensile and compression creep behavior of high density polycrystalline alumina and beryllia. (auth)

31187 (NP-10655) DUKE MICROWAVE LABORATORY REPORT NO. 33, APRIL 1, 1961–JUNE 30, 1961. (Duke Univ., Durham, N. C.). Contract AF49(638)-765. 110p. Includes papers: ELECTRON SPIN RESONANCE INVESTIGATIONS OF THE PROTEINS. Walter Gordy; ELECTRON SPIN RESONANCE OF AN IRRADIATED SINGLE CRYSTAL OF UREA OXALATE. D. V. G. L. Narasimha Rao and Walter Gordy. Published in J. Chem. Phys., 34: 362-8 (1961); ESR SPECTRA OF A GAMMA-IRRADIATED SINGLE CRYSTAL OF DL-SERINE. D. V. G. L. Narasimha Rao and Walter Gordy; ASYMMETRY OF CYCLOTRON RESONANCE LINES IN THE REACTION ZONES OF LOW-PRESSURE ACETYLENE AND CYANOGEN FLAMES. E. M. Bulewicz and P. J. Padley.

Electron spin resonance (ESR) studies of proteins revealed two kinds of patterns: a simple doublet similar to that of irradiated peptide glycylglycine; and an asymmetric, field-dependent pattern like that of irradiated cysteine or cystine. One of the characteristic patterns depends on the presence of the peptide bond, while the other does not. Studies of resonance patterns of irradiated cysteine and cystine indicated that the cysteine-like resonance in the protein is not intimately associated with the polypeptide backbone but rather the sulfur-containing side group.

Analysis of the ESR of irradiated urea oxalate crystals leads to the conclusion that the free radical has the form RCHOH and is probably:  , with the electron spin density concentrated mostly on the CH carbon. The radical was found to be very stable, the ESR pattern being essentially undiminished for more than a year after irradiation.

The ESR spectra of gamma-irradiated deuterated DL-serine crystals was observed for which, the only component with significant intensity, six months after irradiation, was the isotropic doublet of 40 gauss separation. A free radical is proposed to explain the isotropic doublet:



the spectroscopic splitting factor for H along the crystalline axes, a, b, and c, are tabulated.

The effect of the marked asymmetry and line shift for cyclotron resonance lines observed in the reaction zones of low-pressure flames containing high concentrations of free electrons is interpreted in terms of the variation of the real part of the refractive index of the flame plasma at microwave frequencies in the neighborhood of the absorption line. (B.O.G.)

31188 (NP-10723) STUDY OF COMBINATIONS OF HIGH AND LOW ELASTIC MODULUS CERAMIC MATERIALS. Sixth Quarterly Report, June 15–September 15, 1961. Peter T. B. Shaffer and Dick P. H. Hasselman (Carborundum Co. Research and Development Div., Niagara Falls, N. Y.). Sept. 18, 1961. Contract AF33(616)-6806. 33p.

Additional property values were obtained for the composite bodies of ZrC–graphite SiC–graphite during the report period. Thermal shock tests on spheres composed of ZrC-graphite were carried out using a radiation–convection boundary condition. The actual volume fraction of graphite in the ZrC–graphite composites is being determined by metallographic means. Calculations were made of the maximum thermal stress, time of maximum stress, and the center, surface and mean temperature at the time of maximum stress in a spherical body subjected to transient thermal shock. On the basis of these calculations the predicted thermal shock behavior of spherical shapes as investigated by Crandall and Ging were recalculated. To simplify these calculations a graphical method was devised. Good agreement with experimental values was obtained. (auth)

31189 (NP-10739) PROGRESS REPORT NO. XXIX, [ON INSULATION RESEARCH]. (Massachusetts Inst. of Tech., Cambridge. Lab. for Insulation Research). July 1961. Contracts Nonr-1841(10); AF19(604)-5482, et al. 55p.

Development work on a small spectrograph for use in a variety of analyses is described. Comparison of various other destructive and nondestructive analytical techniques is in progress. Efforts devoted to studies of single crystals are discussed along with work on preparation of polycrystalline samples. Initial work in a program to develop and test high temperature dielectrics is described. Aspects emphasized include temperature coefficient of the dielectric constant, the onset of ferroelectricity, effects of ion substitutions and vacancies in the perovskites, frequency response of ferroelectrics, effects of H bonding, mobilization and injection of charge carriers, and electric breakdown. Other work is reported on magnetic dipole moments, magnetic spectroscopy, masers, and the behavior of dipole systems. (J.R.D.)

31190 (NP-10747) URANIUM IN STEEL. S. L. Gertsman (Canada. Dept. of Mines and Technical Surveys. Mines Branch). Jan. 30, 1961. 9p. (PM-M-61-5; CURF-R-3)

The effects produced by additions of uranium to steel were investigated. Addition of uranium to molten steel was successfully carried out on 500 lb heats. The recovery of uranium in this type of steel was of the order of 25%. It was found that uranium contents of 0.7% have an effect on hardenability. In short tests at 50°C in oxygenated solutions of HNO_3, H_2SO_4, and HCl, uranium-containing steels exhibited less pitting and corrosion than control samples. Uranium increased the fatigue strength of plain carbon steels. Stress rupture tests of steels showed an increase in time to rupture at a given stress and temperature with uranium added. (M.C.G.)

31191 (NP-10758) URANIUM MASTER ALLOYS FOR LABORATORY MELTS OF URANIUM STEELS. Charles E. Makepeace (Canada. Dept. of Mines and Technical Surveys. Mines Branch). Jan. 5, 1961. 21p. (PM-R-61-1; CURF R-4)

Laboratory melts of Fe–12 wt % U and Fe–50 wt % U, Ti–24 wt % U, and Al–12 wt % U, successfully used as master alloys in steel melting, were examined metallographically. (auth)

31192 (NP-10765) CANADIAN URANIUM RESEARCH FOUNDATION FELLOWSHIP REPORT NO. 6101 [FOR] PERIOD, APRIL 16, 1961–MAY 15, 1961. (Canada. Ontario Research Foundation, Toronto). May 30, 1961. 38p. (CURF R-8)

The fundamental conditions governing the formation of oxide glasses are reviewed and the possible role of uranium in glass is briefly discussed. Results of preliminary investigations in the systems $Li_2O-B_2O_3$, $UO_2-B_2O_3$, and UO_2-NaPO_3 are presented. There is good agreement between published results and the liquidus and x-ray data obtained for the compositions studied in the system $Li_2O-B_2O_3$. Only one composition was studied in the system $UO_2-B_2O_3$; considerable difficulty was experienced in dissolving UO_2 in B_2O_3. Glass formation in the system UO_2-NaPO_3 appeared to be easy; glasses containing up to 40% UO_2 were prepared. (auth)

31193 (NP-10776) DEFENSE METALS INFORMATION CENTER SELECTED ACCESSIONS. Virginia L. Adams, comp. (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Sept. 1961. 71p.

A listing of 132 selected documents and journal articles in abstracted form on metals is presented. Materials covered include Co alloys, Ni alloys, steels, Fe alloys, Be, Ti, Mg, C, ceramic oxides, special refractories, Nb, Mo, Ta, Va, W, Pt group, and coatings. Fabrication of these metals and their applications are treated. (M.C.G.)

31194 (NP-10777) PYROLYTIC GRAPHITE: AN ANNOTATED BIBLIOGRAPHY. A. A. Beltran, comp. (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). July 1961. Contract NORD-17017. 68p. (SB-61-44)

The literature concerned with the production, properties, and nondestructive testing of pyrolytic graphite, pyrocarbide, pyrofiber, pyrographalloys, and high density graphite is covered. Uses of the materials as coatings and free standing components; fabrication methods and equipment; quality control; and test procedures are reviewed. Subject and source-report number indexes are included. 135 references. (B.O.G.)

31195 (NP-10785) HARD PARTICLE STRENGTHENING OF REFRACTORY METALS FOR HIGH TEMPERATURE USE THROUGH INTERNAL OXIDATION. Progress Report No. 4, July 1, 1961–August 31, 1961. A. S. Bufferd, K. M. Zwilsky, and N. J. Grant (New England Materials Lab., Inc., Medford, Mass.). Sept. 29, 1961. Contract NOw-61-0316-c. 9p.

Nine billets of internally oxidized Mo–1.5% Ti were prepared for extrusion. None of these was extruded satisfactorily either in a Dynapac or a conventional high speed press. It is believed that the low density of the billets is responsible for this and several billets are being prepared which will be upset prior to extrusion. (auth)

31196 (NP-10793) THE TENSILE AND IMPACT STRENGTH OF ANNEALED AND WELDED 5086 ALUMINUM DOWN TO 20°K. R. P. Mikesell and R. P. Reed (National Bureau of Standards. Cryogenic Engineering Lab., Boulder, Colo.). [nd]. 13p.

Tests were made of the tensile and impact strength of annealed and welded 5086 Aluminum alloy down to 20°K. The behavior in mechanical properties of both the tensile and impact specimens as a function of temperature was approximately the same for the annealed and weld metals. The tensile strength of the annealed specimens increased by about 80% between 300 and 20°K. The yield strength increased by about 15%. The tensile strength of the weld specimens increased by about 40% between 300 and 20°K and the yield strength increased by about 35%. Despite the drop in elongation between 76 and 20°K, the annealed tensile specimens still exhibited some plastic deformation at 20°K. The impact strength of the annealed specimens decreased by about 25% between 300 and 24°K. The impact strength of the weld specimens decreased by about 35% between the same temperatures. A relation between initial strain for discontinuous yielding and strain rate was established. (M.C.G.)

31197 (NP-10795) THE LIQUID RANGE OF METALS AND SOME OF THEIR PHYSICAL PROPERTIES AT HIGH TEMPERATURES. A. V. Grosse (Temple Univ., Philadelphia. Research Inst.). Sept. 5, 1960. 42p.

The liquid range of metals is outlined. The critical properties and the liquid range of mercury, the only metal so far investigated experimentally, are discussed. Critical temperatures, vapor pressures and critical pressures, liquid range diagrams of typical metals, relationship between the density temperature coefficients and critical temperatures of metals, viscosity of liquid metals, empirical relationship between the activation energy of viscosity and the melting point of the metal, the self-diffusion coefficient of liquid metals, electrical conductivities of liquid metals, chemistry of metals at high temperatures, and new electrical heating methods are discussed. (M.C.G.)

31198 (NP-10814) HEAT CAPACITY OF A LIQUID INDIUM–TIN ALLOY. Third Technical Report. Raymond L. Orr, Henri J. Giraud, and Ralph Hultgren (California. Univ., Berkeley. Materials Research Lab.). Oct. 1, 1961. Contract Nonr-222(63). 21p.

The heat capacity of a liquid indium–tin alloy containing 47.22 atomic percent tin has been measured as a function of temperature in an isothermal calorimeter. The data extend from 394°K, slightly above the alloy eutectic temperature, to 758°K. The measured Cp values decrease with temperature, the rate of decrease becoming smaller as the temperature increases, resembling the behavior shown by pure liquid metals for which precise data are available. The magnitude of the decrease in Cp for the alloy above its eutectic temperature has been found to be considerably greater than those found in previous investigations on the pure liquid components. Above the melting temperature of Sn, the alloy Cp data are compared with values calculated from Kopp's Law using previously reported data for the pure liquid components. It is found that, well within the over-all accuracy of the data, $\Delta Cp = 0$ for the formation of the liquid alloy from the liquid elements at temperatures where it can be evaluated. This is consistent with the results of reported heat of formation and activity data for the liquid solution which indicate it to approach closely the properties of an ideal solution and suggest the absence of strong unlike atom interactions. The rapid change of Cp with T for the liquid alloy above its eutectic temperature is interpreted as being due primarily to the same mechanisms responsible for similar behavior in pure metals and not to an increase in ΔCp with decreasing temperature. Assuming $\Delta Cp = 0$ for the liquid alloy at temperatures below the melting point of Sn, Cp values for supercooled liquid In and supercooled liquid Sn have been calculated. The postulated Cp curves so derived join smoothly with those for the liquid metals above their melting temperatures. (auth)

31199 (NRL-5620) PROTECTION OF REFRACTORY METALS FOR HIGH TEMPERATURE SERVICE. Progress Report No. 3, January 1, 1961 (Further Work on the Zinc-

Base Coating for Niobium). G. Sandoz, R. A. Meussner, R. J. Goode, T. C. Lupton, R. J. Hicks, R. L. Newbegin, J. Stoop, J. Smith, S. W. Strauss, and A. J. Pollard (Naval Research Lab., Washington, D. C.). Mar. 24, 1961. 36p.

Studies were made on the equilibria of niobium and zinc and on the interstitial impurities in the niobium. In addition, studies of the kinetics of formation of the various niobium–zinc compounds on niobium from zinc vapor were made. Oxidation tests were made to evaluate the protective qualities of coatings applied in this way. The development of work aimed at increasing the life and reliability or raising the temperature limitations of zinc-based coatings by the introduction of alloying elements was extended. (auth)

31200 (ORO-468) CHARACTERIZATION OF UO_2 POWDERS. Progress Report No. 8, May and June 1961. [James F. Carpenter] (United Nuclear Corp. Chemicals Div., Hematite, Mo.). July 19, 1961. Contract AT(40-1)-2699. 9p.

Correlation of a number of physical and chemical properties of 12 different UO_2 powders was continued. The UO_2 powders were studied by means of infrared absorption measurements, oxidation temperatures as determined by hot stage microscopy techniques, and B. E. T. surface area measurements. Additional pellets were prepared to study ceramic performance. (M.C.G.)

31201 (PWAC-351) HIGH TEMPERATURE STRENGTH PROPERTIES OF COMMERCIAL AND VACUUM MELTED HAYNES ALLOY NO. 25. W. Lieberman and G. H. Rowe (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). June 30, 1961. Contract AF33(600)-40548. 23p.

Tensile and creep rupture tests in air on commercial air melted Haynes Alloy No. 25 in the solution heat treated condition were in good agreement with commercially published information. Rupture life in sodium at 1500 and 1650°F was three to four times the corresponding life in air at the same temperatures. Material that was subjected to a simulated diffusion bonding and brazing treatment exhibited a reduction in tensile ductility in tests up to 1000°F and normal tensile ductility at 1600°F. The tensile and creep-rupture strength of vacuum arc melted material tested in air appeared similar to that of commercial air melted material. Tensile tests on solution heat treated material indicated somewhat lower yield strength when compared to commercial material, although the ultimate strength generally was comparable. Aging at 1400°F increased the ultimate and yield strength with no adverse effect on ductility in subsequent tensile tests at 1400°F. Aging at temperatures above 1400°F did not appear to affect the tensile properties in subsequent tensile tests at the aging temperature. (auth)

31202 (R60FPD307) PROTECTIVE COATINGS FOR MOLYBDENUM ALLOYS. Summary Report, March 20, 1959–March 20, 1960. J. W. Graham and W. B. Hall (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Mar. 31, 1960. Contract NOas 59-6026-c. 95p. (AD-259028)

Two Mo coating tasks were studied. One involved an investigation of four commercial coatings at 2200°F by thermal shock, flexure, and impact tests. A thorough analysis was made of the coating failures, based on fundamental relationships of the coating and base materials, their process parameters, and thermal stress differentials. The relative merit of the coating life at 2200°F was established by relating the consistency of test life to the crack frequency which occurred during testing. The second task involved the study of fundamental relationships existing in an approach to infiltrate refractory glasses into flame sprayed oxide coatings on Mo and on Nb and Ta bond coats deposited on Mo by arc and plasma spraying and vacuum sputtering. Studies were made on coating reactivity with base metal, surface tension, elasticity, differential stress, and metallic oxidation and diffusion. (auth)

31203 (SC-4637(RR)) THE HUGONIOT EQUATION OF STATE OF 6061-T6 ALUMINUM AT LOW PRESSURES. C. D. Lundergan (Sandia Corp., Albuquerque, N. Mex.). Sept. 1961. Contract AT(29-1)-789. 19p.

The Hugoniot equation of state of 6061-T6 aluminum was determined in the pressure region from 0 to 31 kilobars. The one-dimensional shock waves, which were used to compress the medium, were produced by impacting an aluminum target with a flat-nosed projectile. The elastic shock wave velocity was measured as 6.23 ± 0.15 mm/μs. Above the Hugoniot elastic limit of 6.3 ± 0.1 kilobars both elastic and plastic shocks were observed. The particle velocity behind the shock front, determined at the plane of impact, was compared to the free surface velocity. Above the elastic limit the free surface velocity was less than twice the initial particle velocity and appeared to be a function of the thickness of the target. (auth)

31204 (SEP-96(Del.)) THE POWDER METALLURGY OF ZIRCONIUM–URANIUM ALLOYS. PART I. Herbert S. Kalish and Henry H. Hausner (Sylvania Electric Products Inc., Bayside, N. Y.). July 3, 1952. Decl. with deletions Feb. 4, 1960. 39p.

Factors which have noticeable effects on U–Zr fuel elements are examined. Factors considered include the corrosion resistance of Zr to high pressure water, the behavior of the Zr to Zr–U bonding the radiation stability of the fuel element, and the core homogeneity. Most of the work was devoted to a study of core homogeneity. (J.R.D.)

31205 (USBM-U-839) QUARTERLY METALLURGICAL PROGRESS REPORT NO. 11 FOR THE PERIOD OF APRIL 1, 1961 TO JUNE 30, 1961. (Bureau of Mines. Albany Metallurgy Research Center, Ore.). Contract AT(11-1)-599. 38p.

Sodium Reduction of Thorium Tetrachloride. Decomposition of $Th(NO_3)_4 \cdot 4H_2O$ to the oxide was studied under a variety of conditions. The effects of various chlorination agents on the final purity of the resulting tetrachloride were investigated. Tests were made on the sodium reduction of the tetrachloride, and the purity and hardness of the resulting Th metal are reported. Uranium Reduction. A two-step reduction process for producing U metal from UF_6 was developed using boron nitride crucibles. Zirconium–Hafnium Separation. Solutions containing up to 18.5% Hf were prepared from zircon by selective crystallization of K_2ZrF_6 from K_2HfF_6. $ZrCl_4$ containing 2.3 to 3.9% Hf was selectively reduced to form volatile products containing more than 10% Hf. Hafnium Alloys. Phase studies of Hf–Ta and Hf–V alloys are reported. Rare Earth Alloys. Phase studies are reported for Cr–Gd and AISI 304 type stainless steel–Gd alloys. Niobium–Tantalum Welding. Results of cold-rolling and welding of Nb and Ta are reported. Reactive Metals Melting. Copper crucibles were designed for melting Zr and Mo. Electron beam melting studies of reactor materials are reported. Several shaped pieces of hafnium carbide were cast. (D.L.C.)

31206 (AEC-tr-4246) MICRO-STRUCTURES OF SINTERED URANIUM DIOXIDE PELLETS. Shuichiro Takahaski, Tadashi Kubota, Hajime Uchikoshi, and Hidekazu Doi. Translated from J. At. Energy Soc. Japan, 2: 73-7(1960). 6p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 12964.

31207 (AEC-tr-4834) INFORMATION ON THE SYSTEMS URANIUM–ZIRCONIUM–(HAFNIUM, NIOBIUM, TANTALUM) CARBON. F. Benesovsky and E. Rudy. Translated from Planseeber. Pulvermet., 9: 65-76(1961). 10p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 19925.

31208 (AEC-tr-4836) COMBUSTIBILITY OF MAGNESIUM AND URANIUM HEATED IN DIFFERENT GASEOUS MEDIA. R. Darras, P. Baque, and D. LeClercq (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). Translated by Helen Basil (Argonne National Lab., Ill.) from report NP-9715. 1959. 53p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 5980.

31209 (DEG-Inf-Ser-237) THE INFLUENCE OF RARE METALS ON THE MECHANICAL PROPERTIES OF IRON–ALUMINUM ALLOYS. E. M. Savitskii, V. F. Terekhova, and I. V. Burov. Translated by E. Bevitt (U.K.A.E.A., Risley Lancs, Eng.) from Metalloved. i Termicheskaya Obrabotka Metal., No. 3, 38-43(1959). 7p.

Investigations on the effects of metals such as Zr, Ti, Ta, Ce, V, B, Mo, and Nb on Al–Fe alloys were conducted. Discussions of microstructure, mechanical and magnetic properties of various combinations are given, however tables and figures referred to in the report are not included. (J.R.D.)

31210 (NP-tr-734) NIOBIUM IODIDE [IODIDE NIOBIUM] AND SOME OF ITS PROPERTIES. V. S. Emelyanov (Yemelyanov), A. I. Evstyukhin (Yevstyukhin), and G. A. Leont'ev (Leontyev). Translated from Met. i Metalloved. Chistykh Metal. Moskov. Inzhener. Fiz. Inst., Sbornik Nauch. Rabot, No. 2, 27-45(1960). 39p.

A discussion is given of studies of the thermal dissociation of niobium iodides. The thermal dissociation process results in a twofold decrease in the hardness and the disappearance of the second phase in the microsections of the iodide niobium. Crystallization during sedimentation from the gaseous phase was found to depend on the filament temperature. The optimum regime for the production of finely grained plastic bars is outlined. The rate of crystal growth rises proportionately to the increase of the filament's temperature, while the elevation of the flask's temperature leads to a maximum growth rate, observable at 350 to 360°C. A decrease in the growth rate with a further rise of temperature is explained by the passivating action of lower formed iodides. The effects of interruptions in the plating process on the crystal growth on the surface of the bar are discussed. Smelting of iodide niobium using an electronic beam was tested which resulted in additional purification, and retention of the second phase observable in microsections of the bars. (B.O.G.)

31211 (NP-tr-767) SPECTRUM AND ZEEMAN EFFECT OF TRIVALENT THULIUM IN THULIUM ETHYLSULFATE. U. Johnsen. Translated by W. G. Perkins and G. A. Crosby (Univ. of New Mexico, Albuquerque) from Z. Physik, 152: 454-69(1958). 14p.

The absorption spectra of the Tm^{+3} ion are investigated, in hexagonal $Tm(C_2H_5SO_4)_3 \cdot 9H_2O$, and in isomorphous diluted mixed crystals, between 8000 and 4500Å in polarized light with high dispersion at 4.2 and 80°K. From the number and polarization of the lines and from their Zeeman effect, the symmetry quantum numbers, Γ, of the observed components of the terms are derived, and the angular momentum quantum numbers, J, L, and S, of the terms are determined. The transitions corresponding to the four observed line groups are described. Transitions which are forbidden in the electric crystal field are forced by strong external magnetic fields. Some terms and transitions are strongly broadened by resonance coupling between the thulium ions and exhibit a crystal hyperfine structure. In these cases only at extreme dilution could the terms and their Zeeman effect be described by the single atom model. (auth)

31212 (NP-tr-774) HIGH ALLOY STEELS AND HEAT RESISTANT ALLOYS. N. I. Korne'ev (Korneyev) and I. G. Skugarev. A translation of p.80-149 of "Osnovy Fiziko-Khimicheskoy Teorii Obrabotki Metallov Davleniyem," Moscow, 1960. 102p.

Studies were made of the plasticity of steels and heat-resistant alloys. Plasticity diagrams of highly alloyed steels, variations in the plasticity and deformation resistance in relation to the status of tension, deformation resistance of high-alloy metals, changes in macrostructure and in mechanical characteristics in relation to general deformation, diagrams of work-recrystallization establishing work temperatures and critical deformations, structure of high-alloy materials and its effects on plasticity, and thermo-mechanical conditions for pressure working high-alloy metals are discussed. (M.C.G.)

31213 (NP-tr-784) STRUCTURE DIAGRAM AND SOME PROPERTIES OF ALLOYS OF THE SYSTEM NIOBIUM–MOLYBDENUM–VANADIUM. V. V. Baron, K. N. Ivanova, and E. M. Savitskii (Savitsky) (Savitskiy). Translated from Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo, No. 4, 143-9(1960). 17p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 1870.

31214 (PA-Trans-50) DIAGRAMS OF PHASE TRANSFORMATIONS OF BINARY SYSTEMS FORMED BY NITRATES OF RUBIDIUM AND CESIUM WITH THE NITRATES OF STRONTIUM AND BARIUM. V. E. (Ye.) Plyushchev, I. B. Markina, and L. P. Shklover. Translated for Picatinny Arsenal, Dover, N. J. from Zhur. Neorg. Khim., 1: 1613-18(1956). 10p.

Phase studies were made of the binary systems formed by the nitrates of alkali and alkali earth metals: $RbNO_3$–$Sr(NO_3)_2$, $CsNO_3$–$Sr(NO_3)_2$, $RbNO_3$–$Ba(NO_3)_2$, and $CsNO_3$–$Ba(NO_3)_2$. Salt fusions were used for recording the heating curves. The eutectic points were found graphically and confirmed experimentally. (M.C.G.)

31215 (UCRL-Trans-711) THE SHAPE OF PARTICLES DURING PRECIPITATION OF CARBIDE IN α-IRON. W. Pitsch. Translated for Univ. of California Lawrence Radiation Lab., Berkeley from Acta Met., 3: 542-8(Nov. 1955). 25p. (Includes original, 6p.).

Results of experiment indicate that the precipitated particles are plate-like. It was also found that coagulation takes place during precipitation. (J.R.D.)

31216 (UCRL-Trans-712) ON THE SHAPE OF PARTICLES DURING PRECIPITATION OF CARBIDE IN α–IRON. W. Pitsch. Translated for Univ. of California Lawrence Radiation Lab., Berkeley from Acta Met., 5: 175-6(1957). 5p. (Includes original, 2p.).

Experiments from a previous publication were evaluated on the same material under similar conditions, and the precipitated carbide particles were observed in the electron microscope. The observed carbide particles were exclusively plate-shaped. The precipitation occurred in three planes standing perpendicular to each other. The precipita-

tion forms of carbide in alpha-iron were quantitatively confirmed. (P.C.H.)

31217 (UCRL-Trans-713(L)) STUDY OF URANIUM–MOLYBDENUM ALLOYS. Jean Bellot, Pierre Dosiere, and Jean-Marie Henry. Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Livermore) from Metaux (Corrosion-Inds.), 33: 343-52(Sept. 1958). 24p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 23347.

31218 (UCRL-Trans-714(L)) CONTRIBUTION TO THE STUDY OF URANIUM ALLOYS BY THERMAL DIFFERENTIAL ANALYSIS UNDER VACUUM. J. Bellot, J. M. Henry, and G. Cabane. Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Livermore) from Mém. sci. rev. mét., 56: 301-6(1959). 13p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 3802.

31219 (UCRL-Trans-718(L)) THE AMORPHOUS STATE OF METALS. J. Kramer. Translated by G. A. Condas (Univ. of California Lawrence Radiation Lab., Livermore) from Z. Physik, 106: 675-91(1937). 17p.

The basic difficulties in the production and the proofs of the amorphous state are discussed. The individual methods for the transformation into the amorphous state are presented with their advantages and disadvantages. For metals in which the amorphous form was produced the transformation temperatures are given. It is shown that the transformation of all metals into the amorphous state is only a question of the existing experimental means. (auth)

31220 CONTRIBUTION TO THE STUDY OF REFRACTORY CONCRETES. Al. Braniski. Acad. rep. populare Romîne, Studii cercetări met., 6: 85-102(1961). (In Rumanian)

After a short introduction on refractory concretes, the effect of different cements on the refractoriness of aluminous cements of Sr and Ba with respect to the refractoriness of calcium aluminous cements is examined. The method for calculating the mineralogic composition (phasal or potential) of refractory barium aluminous cements is then given. The effect of the cement concentration on the resistance to hot compression of aged and unaged refractory concretes was investigated for six hours at 1000 or 1400°C. The effect of an increase in the cement concentration on the pyroscopic resistance of refractory concretes was compared with barium aluminous cement and the pyroscopic resistance of refractory concretes with calcium aluminous cements. (tr-auth)

31221 THE THERMAL CONDUCTIVITY OF MOLTEN SALTS. II. THEORY AND RESULTS FOR PURE SALTS. A. G. Turnbull (C.S.I.R.O. Chemical Research Labs., Melbourne). Australian J. Appl. Sci., 12: 324-9(Sept. 1961). (In English)

A theory is developed for calculating the thermal conductivity of molten salts by treating it as the sum of a diffusional contribution, which is estimated from the self-diffusion coefficient to be only a small percentage of the total, and a vibrational contribution. The determination of the thermal conductivity of seven pure inorganic salts in both liquid and solid state near the melting point provides confirmation of the theory. (auth)

31222 EPITAXY AND TWINNING IN FOILS OF SOME NOBLE METALS CONDENSED UPON LITHIUM FLUORIDE AND MICA. M. J. Hall and M. W. Thompson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Brit. J. Appl. Phys., 12: 495-8(Sept. 1961). (AERE-R-3591)

Foils up to 2.5×10^{-3} cm in thickness, of Cu, Ag, Pd, and Au, were evaporated onto LiF and mica crystals, epitaxial growth was observed within fixed temperature ranges for each substrate-metal combination. X-ray diffraction of the foils produced sharp patterns of spots which indicated a principal orientation of crystallites in direct alignment with the substrate crystal, together with twins whose presence was confirmed by metallography. The observations are discussed in terms of a nucleation and growth model. (auth)

31223 SOME THERMAL AND MAGNETIC PROPERTIES OF TANTALUM, NIOBIUM, AND VANADIUM AT HELIUM TEMPERATURES. A. Calverley (Services Electronics Research Lab., Baldock, Herts, Eng.), K. Mendelssohn, and P. M. Rowell. Cryogenics, 2: 26-33(Sept. 1961). (In English)

Measurements of the thermal conductivity of tantalum, niobium, and vanadium in the normal and superconducting states were made using specimens of various chemical purities and crystalline states. The difference between annealed monocrystals and strained polycrystals is discussed and the contribution in the superconductive state of the lattice waves at temperatures below one-sixth of the transition temperature is clearly shown. The thermal resistance in the intermediate state was measured for the purest monocrystals of tantalum and niobium, and the critical field curve for a monocrystal of tantalum was determined. (auth)

31224 THE HEAT OF DISSOCIATION OF KURNAKOV'S COMPOUNDS Ni_3Fe, Ni_3Mn, Ni_3Cr AND Ni_3V. I. I. Kornilov and N. M. Matveeva (Baikov Inst. of Metallurgy, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 139: 880-3(Aug. 1, 1961). (In Russian)

The heat for the transition of a compound into a solid solution at the critical temperature of the transition was determined thermographically after annealing for 700, 1000 and 1400 hours. The $\alpha \rightarrow \beta$ and the $\beta \rightarrow \gamma$ transitions in iron were used as standards in measuring the amount of heat. The Ni_3Me alloys (where Me refers to Fe, Mn, Cr and V) were prepared in an electric arc furnace in an argon atmosphere. The heat of dissociation ΔH was found to be 1.9 kcal/gram-atom for Ni_3Fe at a transition temperature T of 570°C, 2.40 kcal/gram-atom for Ni_3Mn at T = 540°C, 0.41 kcal/gram-atom for Ni_3Cr at T = 585°C, 3.60 kcal/gram-atom for Ni_3V at T = 1070°C and 8.4 kcal/gram-atom for Ni_3Ti at T = 1380°C. The increase in the strength of the chemical bond in the compounds Ni_3Fe, Ni_3Mn, Ni_3Cr(?), Ni_3V and Ni_3Ti should be reflected in the mechanical strength of these compounds. The compound Ni_3Cr requires further investigation because of its low heat of dissociation. (TTT)

31225 A STUDY OF THE $KF-ZrF_4$ SYSTEM. A. V. Novoselova, Yu. M. Korenev, and Yu. P. Simanov (Moscow State Univ.). Doklady Akad. Nauk S.S.S.R., 139: 892-4 (Aug. 1, 1961). (In Russian)

The solid state reactions in the $KF-ZrF_4$ system were followed by differential thermal analysis and by x-ray analysis. Melts containing less than 33.3% ZrF_4 were prepared from potassium fluoride and K_2ZrF_6. Melts with more than 33.3% ZrF_4 were made by fusing the calculated amounts of K_2ZrF_6 and $(NH_4)_3ZrF_7$ in a current of CO_2. The phase diagram for the $KF-ZrF_4$ system, constructed on the basis of the thermal and x-ray analyses, has 28 different regions. The compounds K_3ZrF_7, $K_5Zr_2F_{13}$, K_2ZrF_6, $K_3Zn_2F_{11}$, $K_7Zn_6F_{31}$ and $KZrF_4$ were found in this system.

The fluorozirconates K_3ZrF_7 and $KZrF_5$ melt congruently at 923 and 455°C respectively. The fluorozirconates $K_5Zr_2F_{13}$ and K_2ZrF_6 are formed by peritectic reactions with K_3ZrF_7 and K_3ZrF_7 respectively at 848 and 585°C respectively. The fluorozirconates $K_3Zr_2F_{11}$ and $K_7Zr_6F_{31}$ exist only as solid below 327 and 380°C respectively. The eutectic between KF and K_3ZrF_7 occurs at 760°C and 13% ZrF_4; the eutectic between K_3ZrF_7 and $KZrF_5$ occurs at 430°C and 47% ZrF_4, while the eutectic between $KZrF_5$ and ZrF_4 occurs at 440°C and 60% ZrF_4. A number of modifications of K_2ZrF_6 were detected. The fluorozirconate $KZrF_5$ undergoes polymorphic transformations at 400 and 424°C. A fluorozirconate with a composition of $K_3Zr_2F_{11}$ undergoes a polymorphic transition at 313°C. The compound K_3ZrF_7 has a single modification and forms a solid solution with K_2ZrF_6 (in the region of 73 to 75% KF). (TTT)

31226 THE PHASE DIAGRAM OF IRON-HAFNIUM. V. N. Svechnikov and A. K. Shurin (Inst. of Metallo-Physics, Academy of Sciences, Ukrainian SSR). Doklady Akad. Nauk S.S.S.R., 139: 895-8(Aug. 1, 1961). (In Russian)

Carbonyl iron and iodide hafnium with 0.5% Zr and 0.2% Mo were arc melted in pure argon to prepare 25 alloys containing 0.01 to 97.0 wt % Hf. The transformation in the system was followed by dilatometric, magnetic, x-ray and differential thermal analyses. There are four, solid state transitions in alloys containing up to 45% Hf. Two transitions are magnetic (in the α-iron and the intermetallic); the third is associated with the transition of α-iron to γ-iron, and the fourth with the transition of γ-iron to δ-iron. The maximum solubility of Hf in α-iron (the peretectoid point) is 0.2%. The $\alpha + \epsilon \rightarrow \gamma + \epsilon$ transition temperature was found to be 935°C. The transition $\gamma + \epsilon \rightarrow \delta$ occurred by way of an eutectoid reaction at a temperature of 1330°C. The composition of the eutectoid was 2.8% Hf. The maximum solubility of Hf in γ-iron is 1.6% at 1330°C. Two solid state transitions were found in alloys containing 70 to 99% Hf. The first transition is associated with a magnetic transition of the intermetallic and is accompanied by a substantial change in the thermal expansion coefficient. The second transition is eutectoidal and occurs at 1235°C: $\epsilon + \alpha_{Hf} \rightarrow \beta_{Hf} + \epsilon$. The solubility of iron in hafnium is small (<1%). Differential thermal analyses show that there are two eutectic transitions in the iron-hafnium system: $L \rightleftharpoons \delta + \epsilon$ at 1350°C, and $L \rightleftharpoons \beta_{Hf} + \epsilon$ at 1300°C. The hafnium contents of the eutectics are 21.5 and 85% respectively. X-ray analyses showed that the intermetallic compound Fe_2Hf (ϵ-phase) is hexagonal similar in type to $MgZn_2$. The Vickers hardness of the intermetallic compound $FeHf_2$ was found to be 650 kg/mm^2, and its fusion point was found to be 1810°C. A phase diagram for the iron-hafnium system is presented. (TTT)

31227 THE OPTIMUM THICKNESS OF LEAD FOILS FOR MACROSTRUCTURE INVESTIGATIONS WITH RADIOACTIVE ISOTOPES. J. Hirling (Csepel Iron and Metal Works, Budapest). Isotopentechnik, 1: 159-60(May 1961). (In German)

36 lead combinations with Agfa-Texo-S film were investigated for the optimum amplification effect in the irradiation of various material thicknesses with Co^{60}, Cs^{137}, and Ir^{192}. (tr-auth)

31228 CONCRETE BLOCK CREEP AT ELEVATED TEMPERATURES. M. A. Zadoyan (Inst. of Mathematics and Mechanics, Academy of Sciences, Armenian SSR). Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Mekh. i Mashinostr., No. 4, 130-5(July-Aug. 1961). (In Russian)

The effects of high temperature on the elasticity and creep rate of concrete block are analyzed. The surface of the block is assumed to be ideally heat isolated. Calculations are given of the thermal stress induced by γ radiation. (R.V.J.)

31229 THERMIONIC EMISSION OF UC-Nb. R. H. Abrams, Jr. and F. E. Jamerson (General Motors Research Labs., Warren, Mich.). J. Appl. Phys., 32: 1783-4(Sept. 1961).

Spectral emissivity and thermionic constants were measured on a uranium carbide-niobium disk, UC (80 vol %) – Nb (20 vol %), 2.34 cm in diameter and 0.51 cm thick. The spectral emissivity was found by comparing optical pyrometer readings of the niobium-clad polished surface and a hohlraum, assuming the surface and the interior of the disk to be at the same temperature. The emissivity at 0.65 μ varied from 0.7 at 1100°K to 0.6 at 1700°K. A Richardson plot for UC-Nb was obtained from corrected Schottky curves and was analyzed by a method of least squares to obtain the Richardson constants, ϕ = 3.27 ev and A = 90 amp/cm^2 °K^2. (L.N.N.)

31230 SOME ANISOTROPIC PROPERTIES OF ROLLED URANIUM PLATES. Ko Soeno (Hitachi Ltd., Japan). J. At. Energy Soc. Japan, 3: 614-22(Aug. 1961). (In Japanese)

Anisotropic properties of cold and hot rolled plates were studied by the growth on thermal cycling, thermal expansion coefficients in rolling and transverse directions, and inverse pole figures in the rolling plane. Preferred orientation was found by reductions in thickness in cold or hot rolling. The difference between the thermal expansion coefficients in rolling and transverse directions was increased with increased reductions, but was less in 550°C rolling than in room temperature or 300°C rolling. No essential difference in preferred orientation between room temperature and 300°C rolling was found. (7, 17, 19) – [1$\bar{1}$0] main component and (4, $\bar{1}\bar{7}$, 20) – [410] minor components were observed. (auth)

31231 SOME STUDIES ON METALLURGICAL BEHAVIOR OF MAGNOX ALLOY. I. GRAIN GROWTH AND MECHANICAL PROPERTIES. Ryukichi Nagasaki and Kensuke Shiraishi (Japan Atomic Energy Research Inst., Tokyo). J. At. Energy Soc. Japan, 3: 623-33(Aug. 1961). (In Japanese)

Changes in crystal structure of three kinds of extruded Magnox (Magnox E, C, and A 12) and Mg-1% Al alloys on heat treatment and tensile properties at room and elevated temperatures were investigated. The alloys recrystallize at about 350°C, and the crystal grains grow rapidly into heterogeneous coarse grains as the temperature increases. The growth rate of Magnox A12 grains is the most rapid and that of Be-free Mg-1% Alloy is the slowest. Decreases in hardness and grain growth of these alloys, except Magnox A12, are completed in the first few hours at 300 to 450°C. Grains of Magnox A12 grow heterogeneously during at least 100 hr. For example, grain size of 0.02 mm at room temperature becomes 0.6 mm after heating at 400°C for 62 hr. The results of tensile tests on extruded Magnox alloys at room temperature show 22 ~ 24 kg/mm^2 in UTS, 12 ~ 15% in elongation, and brittle fracture. Strain age-hardening is found in Magnox A12 and C. UTS and elongation of alloys annealed at 350 and 400°C for 100 hr are smaller than in as extruded alloys. The results of the tensile test of extruded Magnox alloys at 350°C under the strain rate of 142.5 ~ 622.5%/hr reveal 2 ~ 3 kg/mm^2 in UTS, 60 ~ 100% in elongation. These alloys show ductile fracture at 350°C without cavitation under the strain rate described. (auth)

31232 ELECTRON MICROSCOPE OBSERVATIONS OF POROSITIES, INCLUSIONS OF CARBON, AND DISLOCATIONS IN BERYLLIUM OXIDE SINTERED UNDER PRESSURE. André Bisson and Henri Frisby (Centre d'Études Nucléaires, Saclay, France). J. Nuclear Materials, 4: 133-42(July 1961). (In French)

Hot pressed beryllium oxide was studied by examining replicas of fractured surfaces in an electron microscope. Apart from porosity remaining from the sintering process, cavities or bubbles were observed which resulted from prolonged heat treatment in air. These bubbles are thought to arise from the oxidation of impurities in the specimens. In fact, carbon precipitates were found to be deposited on dislocations before heat treatment. The study of these precipitates by an independent method demonstrated the correlation between dislocation arrangements, carbon precipitates, and bubble formation. (auth)

31233 FABRICATION AND PROPERTIES OF DENSE BERYLLIUM OXIDE. S. C. Carniglia and J. E. Hove (Atomics International, Canoga Park, Calif.). J. Nuclear Materials, 4: 165-76(July 1961). (In English)

Nuclear grade beryllium oxide powders from commercial suppliers may be pressed at temperatures of 1500° to 1900°C and under pressures from 2000 to 6000 psi in graphite dies into a variety of shapes having densities in the range 98 to 100% of the theoretical value. Addition of 1% MgO facilitates the process and improves the rate and uniformity of densification. The compaction of BeO as a function of pressure, temperature and time may be described by a flow relation involving a viscosity and a critical shear stress for grain boundary movement. Thermal expansion is isotropic to about 1700°C and is well described to 2000°C by a quadratic function of the temperature. The specific heat of BeO at 1500°C is 0.52 cal/g-°C, slightly above the Dulong and Petit value. From 500° to about 1800°C the thermal conductivity decreases as 1/T, from a high value at room temperature of about 0.50 cal/cm-°C for dense material. A decrease in density of 5% diminished the thermal conductivity by approximately 13%. Information given earlier on the creep, elastic and anelastic properties of dense material was extended, and relations were employed showing that significant fractions of thermal stresses encountered in practice may be relaxed if given time. An elasticity due to grain boundaries also appears to confirm the view on flow during densification in hot pressing. A preliminary estimate of rupture strength for completely dense material with grain size of approximately 35 μ is 36,000 psi at room temperature. Lowering the density 1% reduces the strength about 4100 psi. The status of knowledge of other properties is reviewed briefly. (auth)

31234 OPTICAL AND ELECTRONIC MICROSCOPY OF SINTERED URANIUM DIOXIDE. A. Porneuf (Centre d'Études Nucléaires, Saclay, France). J. Nuclear Materials, 4: 200-17(July 1961). (In French)

Methods of preparing surfaces of UO_2 by mechanical or electrolytic polishing, and of revealing the structure by anodic or chemical attack, by bombardment or by oxidation, are described and their respective limitations are analyzed. These various techniques were applied to the study of the influence of preparation conditions on the pore distribution, on the micro-profile of the external surfaces of compacts or of the internal surface of pores, on the surface structure of intergranular boundaries revealed by microfractography, etc. The sensitivity of the various quoted techniques allows patterns to be revealed which are similar to those revealed in metals and which are undoubtedly related to the interaction of dislocations and vacancies. (auth)

31235 MONOCLINIC PHASES IN URANIUM–MOLYBDENUM ALLOYS. J. Lehmann (Centre d'Études Nucléaires, Saclay, France). J. Nuclear Materials, 4: 218-25 (July 1961). (In French)

When uranium–molybdenum alloys containing 4.8 to 9.9 at.% molybdenum are quenched, they undergo a martensitic transformation and phases with a monoclinic structure are formed. The lattice parameters of these phases, designated α_b'', were determined by x-ray diffraction, with the aid of a Seeman-Bohlin camera used with chromium characteristic radiation. The results were used to plot the parameters as a function of increasing molybdenum content. The b parameter progressively diminished, the angle β (between [010] and [100]) increased, up to a value of 92° 37′, while the a and c parameters varied only very slightly. The volume of the monoclinic unit cell decreased with increasing molybdenum content. (auth)

31236 METASTABLE PHASES IN THE URANIUM–MOLYBDENUM SYSTEM AND THEIR ORIGIN. K. Tangri and G. I. Williams (Fulmer Research Inst., Stoke Poges, Bucks, Eng.). J. Nuclear Materials, 4: 226-33(July 1961). (In English)

Composition limits of metastable phases α' and α'', and changes in parameters a, b, c, and angle γ (a b) of the alpha uranium lattice with increasing molybdenum additions, were determined. The b parameter decreased steadily with a very slight increase in a and c, and the angle γ abruptly changed from 90° at 6.2 at.% Mo to 92.4° at 8.4 at.% Mo. A qualitative explanation for the contraction in the b parameter is given. From a study of the effect of cooling rates in producing alternative structures, the relationship between observed structures and their origin was deduced. It is shown that the structures $\gamma°$ and α'', in order, are progressive stages in the generation of α' from the bcc γ phase. It was concluded that whereas increasing additions of molybdenum stiffen the uranium lattice, thus making it more and more resistant to shear, the effect of increased cooling rate is to favor shear and thus carry the transformation toward completion. (auth)

31237 THERMAL ETCHING OF BERYLLIUM. J. Williams and J. W. S. Jones (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Materials, 4: 234-5(July 1961). (In English)

In the thermal etching of beryllium, attention was concentrated on changes of surface topography as a function of annealing time in the temperature range from 900 to 975°C. A single specimen of cast electrolytic beryllium was used. After 30 min at 925°C, a large number of pits of geometrical shape appeared both in the body of the grain, and more infrequently, at grain boundaries. The density of etch-pits was about $10^6/cm^2$. (M.C.G.)

31238 THE VARIATION OF LATTICE PARAMETER WITH CARBON CONTENT OF TANTALUM CARBIDE. Allen L. Bowman (Los Alamos Scientific Lab., N. Mex.). J. Phys. Chem., 65: 1596-8(Sept. 1961).

A lattice constant of $a_0 = 4.4555 \pm 0.0003$ Å was determined for $TaC_{0.994 \pm 0.005}$ at 25°. The equation $a_0 = 4.3007 + 0.1563$ (C/Ta) was calculated relating composition to lattice parameter of TaC. Solution of this equation for $TaC_{1.00}$ gives a lattice parameter of 4.4570 ± 0.0010 Å. (auth)

31239 STEELS CONTAINING NICKEL TREATED AT TEMPERATURES ABOVE AND BELOW THE TOP CRITICAL POINT. G. Mayer (Mond Nickel Co. Ltd., Birmingham, Eng.). Met. ital., 53: 279-89(June 1961). (In Italian)

A systematic examination of the effect of the hardening temperature on the basic mechanical properties of various case-hardened steels was made on 2% Ni–Mo, 0.75% Ni–Cr,

1% Ni–Cr, 2% Ni–Cr, 2% Ni–Cr–Mo and 4.25% Ni–Cr–Mo steels. Data are presented on steels subjected to direct hardening after a pseudo-casehardening at 920° and to single and double hardening at various temperatures around the critical point Ac_3. The results obtained with material subjected to martempering treatment are also presented, and the hardness values concerning the casehardened layer of these steels, treated by different methods, are reported. The casehardened layer has a carbon content between 0.6 and 1.0%. The data given simplify the choice of the heat treatment conditions suitable for obtaining the best properties in the casehardened layer and the best basic mechanical properties. The effect of heat treatment for temperatures between the critical points Ac_1 and Ac_3 on the low temperature properties of 9% nickel steel is described. A comparison is made between rolled and weld steel. (auth)

31240 PRACTICAL CONTRIBUTION TO HEAT TREATMENT OF LIGHT ALLOYS. E. Hugony (Istituto Sperimentale dei Metalli Leggeri, Milan). Met. ital., 53: 290-8 (June 1961). (In Italian)

The heat treatments of aluminum or aluminum alloys are illustrated, and the structural phenomena occurring in the metal under different heating and cooling conditions are indicated. Some practical considerations on the heat treatment of light alloys are given, and the results on some problems with respect to electro-mechanical construction are reported. (auth)

31241 THE PLASTIC DEFORMATION OF BERYLLIUM. H. Weik (Univ. of Cincinnati). Metall, 15: 686-94(July 1961). (In German)

The present state of Be research is reported. Studies on the origin of the brittleness and possible improvement of the deformation properties of Be are given special consideration. It can be considered guaranteed that the basic slip in room temperature deformation leads in technically pure material to the formation of microfissures and resulting fission along the basic plane and the $(11\bar{2}0)$ plane. In very pure Be (99.98%) on the other hand remarkable deformation without fissure formation was observed in basic slip; the presence of foreign atoms can therefore be seen as the reason for the Be brittleness. With regard to technically pure Be, studies were concentrated in previous years on the development of methods through which the basic slip responsible for brittleness in the deformation could be eliminated. Therefore prism slip with respect to the effect of the cleavage and twinning systems was activated and the formation of microfissures was impeded. Works on the investigation of such possibilities and on the effect of the texture, the surface condition, and the temperature on the deformation behavior of multicrystalline Be were discussed. Research on the ligation of columnar crystal formation in cast Be has led to some results; grain refinement was produced in Be by arc fusion. (tr-auth)

31242 HIGH-TEMPERATURE IONIC CEMENTATION. V. S. Vanin (Nikolaev Shipbuilding Inst., [USSR]). Metalloved. i Termichesk. Obrabotka Metal, No. 8, 22-5(Aug. 1961). (In Russian)

The possibility of using heat treatment together with glow discharge for the cementation of articles made of Steel No. 15 was investigated by carburizing the metal with alcohol, water, and acetons mixtures. The glow discharges ensure cleanliness of the surface which is important to prevent the formation of carbon black precipitates or of surface oxide films which enhance the corrosion. In the tests the glow discharge and resistance heating was used to bring the cathode to the desired temperature; in a second series the small anode was heated. Change of the pressure in the system from 2 to 100 mm of Hg did not have any effect on the results; change of the current density from 20 to 100 milliamp/cm^2 or use of pulsating instead of alternating current also yielded negative results. Propane–butane mixtures were found to be better than water–acetone or water–alcohol for cementation beyond 1100°C without melting the sample. At the high temperature range of 1100 to 1300°C the time required for carrying out the cementation was greatly reduced. Combination of cementation and quenching operations makes the process economical. Ionic heating appears to be useable for heating and melting of the metals without oxidizing them. (TTT)

31243 THE EFFECT OF CERTAIN ALLOYING ELEMENTS ON THE HEAT RESISTANCE OF STEEL NO. 15Kh1M1F. E. A. Davidovskaya (Central Scientific Research Inst. of Heavy Machinery, [USSR]). Metalloved. i Termichesk. Obrabotka Metal., No. 8, 26-8(Aug. 1961). (In Russian)

Oxidation of low-alloy pearlitic steels usually starts at 600 to 650°C but water vapor and sulfur compounds in the air phase intensify the corrosive effect. Attempts were made to increase the resistance of these steel, widely used for boiler construction, against such attack by adding Cr, Si, Al, W, Co, or B to the base system. The samples were submitted to a heat treatment including heating up to 1020°C, soaking for 1.5 hours and annealing at 720°C for 5 hours. The corrosion tests were carried out at 600°C for 500 hours. It was found that the resistance is greatly dependent on the atmosphere to which the samples were exposed: For a medium consisting of air, additions, of Cr, Al, and B were most beneficial while Co up to 2 to 3% had hardly any effect. The oxidation process can be expressed by a parabolic curve but for a few more-resistant alloys a logarithmic correlation prevailed. The additives did not reduce the oxidizability of the samples in superheated steam. (TTT)

31244 TEMPERATURE DEPENDENCE OF THE MICROHARDNESS OF WEAR-RESISTANT COATINGS. M. G. Lozinskii, G. G. Zusmanovich, V. S. Mirotvorskii (Inst. of Machine Studies, Academy of Sciences, USSR and All-Union Scientific Research Inst. of Argicultural Mechanization, USSR). Metalloved. i Termichesk. Obrabotka Metal., No. 8, 37-9(Aug. 1961). (In Russian)

Hardness measurements of thin galvanic coatings at elevated temperatures were rendered difficult by the unavailability of a suitable Soviet instrument. In 1958 a testing apparatus was constructed permitting indentation loadings from 5 to 100 g introducing stresses ranging up to 60 kg/mm^2 while heating the specimens up to 1300°C in vacuum. The apparatus was used for studying the temperature dependence of Ni–P and of Cr coatings on Fe. The Ni–P coatings were found to possess the highest hardness at 150 to 350°C and are recommended for increasing the wear resistance of materials exposed to this temperature range. On the basis of high-temperature data, use of Cr coatings is indicated beyond the above-mentioned range. (TTT)

31245 A COMPARISON OF VACANCY AND INTERSTITIAL LOOPS IN GRAPHITE. G. K. Williamson (Berkeley Nuclear Research Labs., Gloucestershire, Eng.) and C. Baker. Phil. Mag. (8), 6: 313-14(Feb. 1961).

The possibility of distinguishing between interstitial and vacancy loops in graphite is discussed along with evidence for Amelinckx's interpretation of the Burgers vector of the vacancy loops. One possible interaction of a loop and a

gliding basal plane dislocation to produce a dislocation arrangement is shown. Graphite heated by direct current in a vacuum and quenched by switching off was studied. (M.C.G.)

31246 DENSITY AND EXPANSIVITY OF SOLID XENON. A. J. Eatwell and B. L. Smith (Univ. of London). Phil. Mag. (8), 6: 461-3(Mar. 1961).

The lattice parameter of solid xenon between 20 and 120°K was determined using the x-ray method of Debye-Scherrer powder photographs and a bulk density method. Values of the density and the volume coefficient of expansion were derived. There was agreement between the results obtained by the two methods. Results are summarized in tabular form. (M.C.G.)

31247 AN X-RAY STUDY OF DEFORMATION STACKING FAULTS AT LOW TEMPERATURES IN LEAD, SOME LEAD ALLOYS, AND ALUMINIUM. G. F. Bolling (Westinghouse Research Labs., Pittsburgh), T. B. Massalski, and C. J. McHargue. Phil. Mag. (8), 6: 491-502(Apr. 1961).

The deformation stacking-fault probability α, was determined by the deformation of bulk specimens of zone-refined lead at 4.2° and 77°K. Aluminum (99.996%), α-brass (70:30), lead-0.1 at. % silver, and lead-20.0 at. % indium were also examined at 4.2°K. It is shown that a major difference exists between aluminum and lead, the latter being copper-like in its value of α. The influence of increased deformation in increasing the value of α is demonstrated. Addition of indium to lead suppressed a measurable value of α which correlated with observations made on twinning in this alloy. (auth)

31248 EFFECT OF IRRADIATION GROWTH ON THE CREEP OF URANIUM UNDER A UNIAXIAL LOAD. W. S. Blackburn (C. A. Parsons and Co., Ltd., Newcastle-on-Tyne, Eng.). Phil. Mag. (8), 6: 503-8(Apr. 1961).

Theories were developed from two different assumptions to calculate the effect of irradiation growth on the creep of uranium under a uniaxial applied stress when the temperature is sufficiently high for the internal stresses set up by the differential expansions of the individual crystals to be insufficient of themselves to cause plastic flow. It is shown that the greater the irradiation growth the greater is the creep rate for a given stress; the effect on creep rate is also greater at lower applied stresses for a given irradiation growth. (auth)

31249 SUPERCONDUCTIVITY OF TECHNETIUM ALLOYS AND COMPOUNDS. V. B. Compton, E. Corenzwit, J. P. Maita, B. T. Matthias, and F. J. Morin (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., 123: 1567-8 (Sept. 1, 1961).

The superconducting transition temperatures of Mo–Tc alloys are reported. Critical field measurements of a 50 atomic per cent alloy indicate that it might be a promising material for superconducting magnets. The similarity of Tc and Re with respect to alloy and intermetallic compound formation is noted. The superconducting transition temperatures of the compounds $ZrTc_6$ and $NbTc_3$ are 9.7°K and 10.5°K, respectively. X-ray diffraction data suggest that these compounds have the α-Mn type structure. (auth)

31250 SUPERCONDUCTING SOLID SOLUTION ALLOYS OF THE TRANSITION ELEMENTS. J. K. Hulm and R. D. Blaugher (Westinghouse Research Labs., Pittsburgh). Phys. Rev., 123: 1569-80(Sept. 1, 1961).

The solid solution alloys formed by the incomplete d-shell metals in groups 4, 5, 6, and 7 were tested for superconductivity down to 1°K. For alloys formed between neighboring elements in a given row of the periodic table, two transition temperature maxima are observed with valence numbers approximately equal to 4.7 and 6.4, respectively, the only exception being the first long period, in which the upper maximum is absent. Similar maxima occur when the constituent elements are selected from different rows of the periodic table, thus confirming the dominant role of the d-shell electrons. It is known that the normal density-of-states function, N(0), passes through a series of maxima as the d-shell is filled up, two of these peaks lying at about the same composition as the two transition temperature peaks observed in the present work. The relationship of T_c to N(0) for the transition metal alloys is discussed. Transition temperature data are also presented for alloys composed of neighboring elements in a given column of the periodic table. In this case, the form of the relationship between T_c and electronic or lattice properties is still obscure. (auth)

31251 CARRIER DENSITIES AND MOBILITIES IN PYROLYTIC GRAPHITE. Claude A. Klein and W. Deter Straub (Raytheon Co., Waltham, Mass.). Phys. Rev., 123: 1581-3(Sept. 1, 1961).

Based on conductivity, Hall effect, and magnetoresistance measurements an attempt is made to describe the behavior of current carriers in the layer planes of well-ordered pyrolytic graphite. The total carrier concentration decreases from 11×10^{18} cm^{-3} at room temperature to less than 4×10^{18} cm^{-3} at very low temperatures, in good agreement with single-crystal results. The average mobility, which is strongly dependent upon the crystallite size, was found to exceed 3000 cm^2/v-sec at liquid nitrogen temperature in specimens deposited at 2500°C; the mobility ratio (μ_e/μ_h) appears to remain temperature independent and equal to 1.08 ± 0.01. (auth)

31252 DIAMAGNETIC SUSCEPTIBILITY OF PYROLYTIC GRAPHITE. D. B. Fischbach (California Inst. of Tech., Pasadena). Phys. Rev., 123: 1613-14(Sept. 1, 1961).

The diamagnetic susceptibilities of some pyrolytic graphites deposited at 2100 to 2300°C were measured at room temperature. As-deposited samples had significantly larger susceptibilities than that of well-graphitized carbons or single-crystal graphite. Heat treatment above 2300°C caused the total susceptibility to decrease to a minimum value, then rise and level out at a value characteristic of graphite, as a function of treatment temperature. The relationship of the susceptibility behavior to the structure of the pyrolytic graphite is discussed. (auth)

31253 SPECIFIC HEATS OF SOME CUBIC SUPERCONDUCTING TITANIUM–MOLYBDENUM ALLOYS BETWEEN 1.1 AND 4.3°K. R. R. Hake (Atomics International, Canoga Park, Calif.). Phys. Rev., 123: 1986-94(Sept. 15, 1961).

Specific heats of four bcc Ti-Mo alloys were measured at 1.1 to 4.3°K, and at atomic fractional Mo concentrations of 0.0625 to 0.0860 (sufficient to stabilize the bcc phase). The normal state molar specific heats can be represented by the usual expression $C_n = \gamma T + \beta T^3$, where it is commonly assumed that $\gamma \propto N(E_F)$, the energy density of electronic states at the Fermi energy, and $\beta \propto \theta_D^{-3}$. For each of the alloys the apparent electronic superconducting state specific heat for $1.3 < (T_c/T) < 2.6$ can be represented as $C_{es}/\gamma T_c = a \exp(-bT_c/T)$ where a = 10.5, b = 1.52, and the superconducting transition temperature, T_c, is taken as the midpoint of the rather broad (≈0.45 K°) superconducting transition. The measured values of T_c, θ_D, and γ are all rapidly varying and nearly linear functions of

atomic fractional Mo concentration, f. At the mean solute concentration (f = 0.0742): T_c = 2.59°K, d ln T_c/df = +16.7; θ_D = 337°K, d ln θ_D/df = −6.2; γ = 5.45 millijoules/mole $(K°)^2$, d ln γ/df = d ln $N(E_F)$/df = +7.7. On the basis of the Bardeen-Cooper-Schrieffer theory of superconductivity, the relative variations of T_c, θ_D, and $N(E_F)$ indicate that the electron-electron interaction parameter of that theory, A, is a relatively slowly varying function of solute concentration (d ln A/df = −3.0). (auth)

31254 INVESTIGATION OF CERTAIN THERMAL AND MECHANICAL PROPERTIES OF HIGH-CARBON STEEL AS A FUNCTION OF THE DEGREE OF DEFORMATION DURING ROLLING OPERATIONS. N. A. Aliev, F. G. Magerramova, and M. M. Musazade. Trudy Inst. Fiz., Akad. Nauk Azerbaidzhan. S.S.R., 10: 69-73(1960). (In Azerbaijanian)

The changes of the thermal conductivity, heat capacity, thermal diffusion, density and microhardness of high carbon-steel specimens were studied by changing the degree of deformation of the pipes with 12- and 14-mm wall thickness. The thinner pipes were subjected to a compression of 12.6%. X-ray studies revealed the presence of second-order stresses which were higher by a factor of 3 in the thin-walled pipes. Comparison of the x-ray data and of the changes in the thermal and mechanical properties indicates that the differential behavior of the specimens is due to differences in the residual stress. (TTT)

31255 THE FINE CRYSTALLINE STRUCTURE AND THE STRUCTURE OF THE ALLOYS OF NON-FERROUS X METALS. A. A. Presnyakov and Yu. F. Klyuchnikov (Lab. of Metallography and Physics of Metals, [USSR]). Trudy Inst. Yadernoĭ Fiz., Akad. Nauk Kazakh. S.S.R., 2: 85-94(1959). (In Russian)

Comparison of the mechanical and physical properties of the Ni−Cu alloy system with their structure permits a definite correlation between them to be established. Although in many cases the plasticity of the alloy and the intensity of the x-ray lines are interrelated in certain concentration ranges, no absolutely valid dependence could be established. A more complete parallelism was noted between the intensity of the x-ray lines and toughness and strength of the alloy because the statistical lattice deformation and the second-order deformation which affects the strength changes together with the binding forces. However, cases were noted in which some of these factors operated in the opposite direction, obscuring the relationship between physical properties and crystalline structure. (TTT)

31256 CORRELATION BETWEEN PLASTICITY, MICROSTRUCTURE AND PHASE COMPOSITION OF ALLOYS. A. A. Presnyakov (Lab. of Metallography and Physics of Metals, [USSR]). Trudy Inst. Yadernoĭ Fiz., Akad. Nauk Kazakh. S.S.R., 2: 101-8(1959). (In Russian)

On the basis of available literature data it is concluded that when alloys undergo a transformation from a single-phase state into a two-phase state, the properties of the metal will depend primarily on the crystal structure of the base phase and not on the microscopic properties of the discontinuous second phase. The processes occurring during annealing and deformation, such as equalization of the grain composition, decomposition phenomena, aging, and recrystallization, are more important for the change of plastic properties than small amounts of a newly formed second phase. Crystal lattice processes are often responsible for embrittlement of alloys. (44 references). (TTT)

31257 THE TEMPERATURE COEFFICIENT OF THE ELECTRICAL RESISTANCE OF THE MANGANIN-TYPE ALLOYS. A. V. Novikov and M. I. Tsypin (Lab. of Metallography and Physics of Metals, [USSR]). Trudy Inst. Yadernoĭ Fiz., Akad. Nauk Kazakh. S.S.R., 2: 119-23 (1959). (In Russian)

The Cu−Ni−Mn alloys which have a high specific resistivity of 0.42 to 0.48 ohm mm^2/m together with a low temperature coefficient, are much used for preparing standard resistances and shunts. It was assumed that within the concentration range of interest the system consists of solid solutions without undergoing any phase transformations, although previous authors noticed a certain amount of instability. For use in the required highly precise instruments the phase structure and the resistance changes must be exactly known and were therefore closely examined. Three transformations were uncovered within the 0 to 100°C range; they might be explained by the fact that the useful alloy composition lies close to the phase transition surface of the ternary system, or they might be due to changes to the electron state of the constitutent atoms, especially of Ni. These changes are probably responsible for the variations in the electric resistance noticed during the study, although the effect of deformation resulting from the fabrication cannot be eliminated. (TTT)

31258 THE NATURE OF PLASTIC FRICTION. A. A. Presnyakov (Lab. of Metallography and Physics of Metals, [USSR]). Trudy Inst. Yadernoĭ Fiz., Akad. Nauk Kazakh. S.S.R., 2: 139-45(1959). (In Russian)

The so-called "plastic friction" which occurs during metal treatment under elevated pressures affects greatly all phases of the plastic deformation process including resistance to deformation, development of the stressed state, embrittlement, wear phenomena or energy consumption during deformation. It is important to differentiate the above phenomena from the sliding type friction which occurs during operation of machines. The plastic deformation which takes place in cases of plastic friction extends in depth into the metal. The relation between the external and internal friction is reflected by the effect of the physical properties on the deformation process. Formation of a "new surface" is also characteristic for the plastic friction. This new motion contradicts the now obsolete theory of the constant rate of flow of metals in the center of deformation. (T T T)

31259 CRYSTAL STRUCTURE OF TERNARY METAL COMPOUNDS. (Review). G. B. Bokii, B. K. Vul'f, and N. L. Smirnova (Inst. of Inorganic Chemistry, Siberian Branch, Academy of Sciences, USSR; Zhukovskii Military Aeronautic Engineering Academy, USSR; and Moscow State Univ.). Zhur. Strukt. Khim., 2: No. 1, 74-111(Jan.-Feb., 1961). (In Russian)

A review is given on the ternary metal compounds systematized into groups according to crystal structure and chemical similarity. 239 references. (R.V.J.)

31260 CRYSTAL STRUCTURE OF Nb_2Al COMPOUNDS. E. I. Gladyshevskii (L'vov State Univ.). Zhur. Strukt. Khim., 2: No. 2, 158-61(Mar.-Apr. 1961). (In Russian)

The crystal structure of Nb_2Al is of the σ phase type with lattice constant a = 9.937 kX and c = 5.157 kX; at 600°C. It is in equilibrium with Nb_3Al and $NbAl_3$. (tr-auth)

31261 METALLURGY OF THE USSR (1917-1957). (Metallurgiya SSR (1917-1957)). I. P. Bardin, ed. Translated from a publication of the State Scientific and Technical Publishing House of Literature on Ferrous and Non-

ferrous Metallurgy, Moscow, 1958. 1002p. (OTS-60-51188; PST-Cat. 119). $10.00(OTS)

Information is presented on the development of metallurgy in the USSR. The development and present state of production of ferrous, nonferrous, rare, and noble metals, of the rolling and tube-rolling industries, of forging and stamping, foundry practice, powder metallurgy, and of the production of light and heavy nonferrous metals and heat-resistant alloys are reviewed. The scientific principles of these industries are discussed. (M.C.G.)

Radiation Effects

Refer also to abstract 30886

31262 (AD-259720) EFFECTS OF ADSORBED MOLECULES AND GAMMA RADIATION ON THE SURFACE PROPERTIES OF GERMANIUM DIODES (thesis). David Mariano Verrelli (Air Force Inst. of Tech., Wright-Paterson AFB, Ohio). Mar. 1961. 35p. (GNE/Phys/61-20).

The reverse current-voltage characteristics of a germanium grown junction were measured both before and during Co^{60} gamma irradiation of 5.65×10^7 ergs/gm C-hour. The ambients were dry oxygen, ozone, and water vapor. For a dry oxygen ambient in radiation, the current rose with increase in voltage until, at a critical value of the voltage, the current droped sharply. No such drop was observed in ozone or water vapor. A theoretical interpretation whereby oxygen molecules are desorbed from the surface is offered to account for the sharp drop. The magnitude of the current below the critical voltage is attributed to an excess surface charge resulting from the transfer of electrons across the oxide barrier. (auth)

31263 (BSR-371) M&TC SYSTEM STUDY, FINAL ENGINEERING REPORT. VOLUME I, PARTS I AND II. VOLUME II. (Bendix Corp. Bendix Systems Div., Ann Arbor, Mich.). Dec. 1960. Contract AF33(600)-35026. 1231p.

A discussion is presented of work conducted to provide radiation-tolerant electronic equipment for use in nuclear-propelled vehicles. The basic philosophy was to increase the radiation tolerance of typical present-day electronic equipment through judicious modification. Components susceptible to radiation damage were replaced on a one-for-one basis with more radiation tolerant components. A typical Mission and Traffic Control (M&TC) subsystem was selected as a model to demonstrate the soundness of the philosophy. Individual sections of each equipment were modified, instrumented, and operated in a nuclear environment. Volume I presents results of the irradiation tests and the modifications performed to achieve the demonstrated increase in radiation tolerance. Included in Volume I are listings of the equipment tested which point out radiation susceptible components and recommended replacements. Volume II is a summary of radiation effects information on electronic components and related materials which was collected and used in carrying out the M&TC System Study. (auth)

31264 (CF-61-1-75(Rev.1)) TECHNICAL FUNCTION AND OPERATION OF THE HIGH RADIATION LEVEL EXAMINATION LABORATORY, BUILDING 3525. (Oak Ridge National Lab., Tenn.). Jan. 31, 1961. 98p.

The nature and scope of the technical services to be rendered and the general plan proposed for operation of Building 3525, High Radiation Level Examination Laboratory (HRLEL), are presented. The role of postirradiation examination in implementing the over-all task of irradiation testing for various programs under way at the Oak Ridge National Laboratory (ORNL) and the importance of this effort to the United States reactor development program are stressed. The shielded-cell complex with provisions for remote decontamination, hot-equipment storage, and maintenance is described, as well as other supporting activities which are incorporated into the facility. The proposed technical functions include general observation, mensuration, nondestructive testing, burnup and induced-activity measurements, fission-gas sampling and analysis, corrosion evaluation and related measurements, disassembly and cutup, metallographic examination, mechanical-property determinations, and x-ray diffraction analyses. Equipment design and operational features to improve detection and measurement of selected properties in radioactive materials are described, also. The current status on design, procurement, construction, and preoperational testing of in-cell equipment in the mockup is presented along with a forecast of future needs. The mode of operation, manpower requirements, and management of the facility are discussed. (auth)

31265 (DP-606) ELECTRON METALLOGRAPHY OF AN IRRADIATED STAINLESS STEEL NOZZLE. Carl L. Angerman (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Aug. 1961. Contract AT(07-2)-1. 20p.

Electron metallography revealed two phases in the grain boundaries of type 304 stainless steel used in the fabrication of a reactor outlet nozzle, but neither phase could be completely identified by either electron or X-ray diffraction. These phases probably contributed to the leaks that developed in the nozzle. (auth)

31266 (NAA-SR-4893) IRRADIATION SWELLING OF URANIUM AND URANIUM ALLOYS. G. G. Bentle (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Sept. 30, 1961. Contract AT(11-1)-GEN-8. 71p.

A study of irradiation data on uranium and uranium alloys was made to determine some of the parameters which affect the swelling of metal fuels during high temperature irradiation. The swelling of uranium measured at various intervals to 0.1 at.% burnup appears to increase linearly with burnup at constant temperature in the SRE. On this basis, the fuel is assumed to have a constant swelling rate at a constant burnup rate up to 0.1 at.% burnup. Irradiation data on uranium from the SRE were compared to MTR data. The total fuel swelling for a given temperature and burnup is about the same in both reactors above 500°C. Since the burnup rate is much higher in the MTR, the calculated swelling rate is also much higher. It was concluded that irradiation affects the swelling rate by increasing the mobility and/or the number of dislocations. On the basis of SRE and MTR results, variations in thermal cycling and thermal stress in uranium slugs during irradiation have a relatively small effect on the swelling. The creep strength of the unirradiated fuels was measured, and the creep strength of the fuels during irradiation was calculated at 485°C. They do not agree at this temperature, but they do agree if the measured creep strength of the unirradiated fuel at 600°C is compared to the creep strength calculated for the fuel under irradiation at about 500°C. This difference, about 100°C, indicates that a decrease in fuel strength may be caused by irradiation. Anisotropic irradiation growth is negligible in the uranium alloy fuels between 350 and 500°C and in uranium above 500°C. The data indicate that anisotropic irradiation

growth is appreciable in α-rolled and β-quenched uranium up to 500°C. (auth)

31267 (NYO-9187) FINAL REPORT [ON CORROSION AND RADIATION DAMAGE RESISTANT FUEL MATERIAL] NOVEMBER 15, 1959 THROUGH NOVEMBER 14, 1960. (Nuclear Materials and Equipment Corp., Apollo, Penna.). Contract AT-(30-1)-2264. 130p.

Coating procedures were developed for Nb, Cr, Mo, V, Nb–5 V alloy, Si, and Be coatings on UO_2 spheres and for Cr coatings on U spheres. The coatings were evaluated by chemical and metallurgical methods to determine purity, corrosion resistance, hardness, etc. The procedures can be scaled up to the pound scale, and the resulting coated spheres can be used for the fabrication of dispersion-type fuel elements by extrusion. An apparatus for making pure U particles was designed and fabricated. (D.L.C.)

31268 (REIC-22) RADIATION EFFECTS STATE OF THE ART, 1960-1961. R. E. Bowman, ed. (Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio). June 30, 1961. Contract AF33(616)-7375. 52p.

A summary is presented of the current state of the art, programs in progress, and conclusions and recommendations concerned with radiation effects studies of: electronic components and equipment; semiconductor devices and materials; polymeric materials; fuels, lubricants, and hydraulic fluids; structural metals and ceramic materials; space radiation; and dosimetry units. A summary is included of the operation of the REIC from May 1, 1960, through June 30, 1961. (B.O.G.)

31269 PHOTOVOLTAIC RESPONSE OF SELENIUM BARRIER LAYER CELLS TO X-RADIATION IN THE ENERGY RANGE OF 15-40 KEV. R. Feinberg and G. E. Rhead (Manchester Coll. of Science and Tech., Eng.). Brit. J. Appl. Phys., 12: 461-4(Sept. 1961).

Twenty selenium barrier layer cells were irradiated with 15 to 40 kev x rays, and their behavior was compared with their response to light. The x-ray sensitivity is independent of intensity at constant anode voltage, but linearly proportional to anode voltage at constant anode current. The form of transient response to x irradiation depends on the intensity of irradiation and the previous history of cell irradiation, a time of rest of about 2 hours being required to achieve the "first-irradiation" response. The fatigue effect does not occur in the steady-state values to photovoltage and photocurrent. There is some evidence for a qualitative relationship between x-ray and optical photovoltage sensitivities of a cell, but there is no relationship between the photocurrent sensitivities. (auth)

31270 MAGNITUDE OF ELECTRIC CURRENT IN A DIELECTRIC AFTER GAMMA IRRADIATION. B. M. Vul (Lebedev Inst. of Physics, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 139: 1339-41(Aug. 21, 1961). (In Russian)

The ionization produced in a dielectric by γ-irradiation causes an increase in electrical conductivity of $\sigma_r = en\mu$, where σ_r is the radiation electrical conductivity, e is the elementary charge, n is the concentration of charge carriers and μ is the mobility. The value of σ_r is directly proportional to the radiation intensity Y for such materials as quartz, sulfur, polyethylene and ceramics in which electron traps are formed. In this case the number of ion pairs formed by irradiation per cm^3 per sec is $g = bY = \beta N(N + N_t)$, where β is the recombination coefficient, N_t is the concentration of traps at steady state, N is the concentration of free electrons at steady state, and b is a term directly proportional to the γ-ray absorption coefficient. If $N_t \gg N$, it can be shown that $\sigma_r = e\mu bY/\beta N_t = aY$. It can be assumed that free electrons are generated only by the γ-irradiation, while electrons are destroyed by recombination with positive ions and by capture by means of the traps. It is shown that if trapping is favored over recombination of electrons, the concentration of free electrons approaches a limiting value proportional to the intensity of γ-irradiation. The current in quartz approaches a higher limiting value at $Y_1 = 0.4$ r/sec than it does at $Y_2 = 0.7$ r/sec. A maximum in the current as a function of time is observed, when recombination is favored over trapping of electrons. This behavior is observed in the γ-irradiation of sulfur at 0.3 r/sec at a temperature of 18°C. (TTT)

31271 EFFECTS OF γ RADIATION ON DIELECTRIC PROPERTIES OF CERTAIN ELECTRIC INSULATING MATERIALS. VI. POLYETHER AND EPOXIDE RESINS E. S. Nesmelova, K. A. Vodop'yanov, and B. I. Vorozhtsov (Tomsk State Univ., USSR). Izvest. Vysshikh Ucheb. Zavedenií, Fiz., No. 2, 120-4(1961). (In Russian)

Investigations of dielectric losses and penetrability of KGMS-2, K-31, ED-6, and MBK-1 insulators before and after irradiation with 10^5 r at various temperatures indicate no noticeable differences. (R.V.J.)

31272 EFFECT OF TEMPERATURE ON THE EXOEMISSION OF ELECTRONS FROM ABRADED ALUMINUM SURFACES. W. T. Pimbley and E. E. Francis (IBM General Products Div., Endicott, N. Y.). J. Appl. Phys., 32: 1729-33(Sept. 1961).

A model and resulting theory for the exoemission of electrons from metal surfaces are presented. The model states that the exoemission is governed by the diffusion of vacancies in the metal, vacancies created by the abrasion. A vacancy, upon diffusing to the surface, may give up its energy to an electron. However, when in the same event, a photon also transfers its energy to the electron, the electron may be emitted. Experiments performed show the exoemission decay to be composed of two exponential decays. Both exponential decay constants vary with temperature according to the equation: $k = Fe^{-E/RT}$. Here, F is a constant and E is an activation energy which, measured, approximates 5.6 kcal/mole. A comparison between experiment and theory gives the theory corroboration. (auth)

31273 ASPECTS OF IRRADIATION DAMAGE IN BERYLLIUM OXIDE. F. J. P. Clarke and J. Williams (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Materials, 4: 121-4(July 1961). (AERE-R-3749(Pt. I)). (In English)

The results of published British experiments on the effects of reactor irradiation on certain physical properties of hot-pressed beryllium oxide are summarized and discussed, with particular reference being made to the technological implications. (auth)

31274 SOME IRRADIATION INDUCED PROPERTY CHANGES IN BERYLLIUM OXIDE. F. J. P. Clarke, G. Tappin, and T. K. Ghosh (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Materials, 4: 125-32(July 1961). (AERE-R-3749(Pt.II)). (In English)

Certain property changes caused by reactor irradiation at ca. 100°C in hot pressed beryllium oxide are recorded. The neutron doses were in the range of 2×10^{18} to 1.5×10^{19} nvt, referred to neutrons with energies greater than 1 Mev. Maximum fractional changes observed were: 4×10^{-4} in macroscopic growth, 5.5×10^{-4} and 1.8×10^{-4} expansion in c and a axes respectively, 2×10^{-3} and 2×10^{-1} in-

creases in resonant frequency and rupture strength respectively. Attention is drawn to the importance of removing residual water prior to canning. (auth)

31275 EFFECT OF HEAT TREATMENT AND IRRADIATION BY NEUTRONS ON THE PHYSICAL AND MECHANICAL PROPERTIES OF BERYLLIUM OXIDE SINTERED UNDER PRESSURE. J. Elston and C. Labbe (Centre d'Etudes Nucleaires, Saclay, France). J. Nuclear Materials, 4: 143-64(July 1961). (In French)

The fabrication of blocks of beryllium oxide by sintering under load is briefly described. This method permits dense compacts of "nuclear purity" to be obtained. Annealing at 1300°C relieves internal stresses in blocks which have been made by sintering under load. Prolonged heat treatment at 1400°C results in an appreciable reduction of the density and deterioration of the mechanical properties of these compacts; this is associated with the precipitation of bubbles of gas at grain boundaries. The effects were examined of neutron irradiation in a reactor on the crystal parameters of beryllium oxide, the length of specimens, the thermal conductivity, and the compressive strength of blocks made by sintering under load. These tests showed a sensitive influence of the oxide density and the irradiation temperature on the stability of the material under neutron irradiation. At a temperature below 100°C, irradiation produces a highly anisotropic dilatation of the crystal lattice. $(\Delta c/c)$ is about ten times greater than $(\Delta a/a)$. This distortion is the cause of the deterioration of the mechanical properties of the compacts. An irradiation of 2×10^{20} neutrons/cm^2 leads to complete disintegration of the compacts (for an irradiation temperature below 100°C). Suitable post-irradiation heat treatment of beryllium oxide compacts made by sintering under load permit the original characteristics of the material to be restored approximately; however, liberation of gas in a compact can lead to a serious deterioration of mechanical properties. Agglomeration of gas at grain boundaries is detectable from 1000°C upwards in irradiated compacts. (auth)

31276 SWELLING IN ALPHA URANIUM DUE TO IRRADIATION. S. F. Pugh (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Materials, 4: 177-99(July 1961). (AERE-R-3458). (In English)

Phenomena thought to contribute to swelling in alpha uranium irradiated up to about ½% burn-up at 400° to 650°C are discussed in the light of recent experiments at AERE. Extensive metallographic examination indicated that in all specimens an array of small bubbles 0.1 microns in diameter and about ½ micron apart, presumably containing most of the fission product gases, is formed. In about 1 in 3 of the specimens, grain boundary cracks contributed about 1% to the volume increase, and were probably due to a combination of irradiation embrittlement and internal stressing caused by thermal cycling. In specimens irradiated at 425°C, ragged holes at the grain boundary were thought to be partly due to irradiation growth. In only three specimens holes up to 2 mm diameter were formed, accompanied by distortion of the specimen and large local volume increases. This was possibly due to severe overheating caused by film boiling in sodium. Acceleration of swelling leading to breakaway due to join up of the small gas bubbles is not expected below 1½% burn-up in α uranium, provided the gas bubbles are always on the fine scale observed so far, but the possibility remains that breakaway swelling at ½% burn-up could be caused by internal cracks collecting sufficient fission product gas to blow up into round bubbles. The mechanism of nucleation and growth of fission gas bubbles in α uranium and the role of surface tension in controlling bubble size are discussed. The arguments for homogeneous nucleation on dislocation lines, for heterogeneous nucleation, for growth of fission product gas bubbles by vacancy diffusion and for growth by plastic deformation of the matrix, are presented. The possible effects of bombarding bubble nuclei and fission product gas bubbles by energetic fission fragments are also discussed. The results of experiments in which uranium irradiated at between room temperature and 350°C was subsequently heated in the range from 500° to 650°C, and the results of investigations on the diffusion and precipitation of xenon, krypton, and other inert gases in uranium and in other metals are reviewed in so far as they throw light on the problem of swelling in uranium. (auth)

31277 DAMAGE IN STAINLESS STEEL DUE TO FISSION FRAGMENTS. P. R. B. Higgins and A. C. Roberts (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nature, 191: 1158-60(Sept. 16, 1961).

An investigation was made by transmission electron microscopy of changes in the microstructure of stainless steel bombarded by fission fragments at 60°C. The steel used was a niobium-stabilized 20% chromium, 20% nickel austenitic stainless steel. Small defects, about 25 Å in diameter, were first seen in the steel after a fission fragment dose of 1.8×10^{14} fragments cm^{-2}. Increasing the dose resulted in an increase in size and number of defects until they were resolvable as dislocation loops. The steel was also subjected to neutron irradiation to determine how much of the observed damage was due to this type radiation. No defects, however, were observed in the electron microscope, but tensile tests showed a characteristic increase in yield stress. The low number of defects per fission event obtained at higher dose rates at 60°C is thought to be due to a large number of unobservable defects. (P.C.H.)

31278 DIFFUSION OF VACANCIES IN IRON–SILICON UNDER IRRADIATION WITH FAST NEUTRONS. H.-D. Dietze and E. Balthesen (Institut für Reaktorwerkstoffe der Kernforschungsanlage, Julich, Ger.). Nukleonik, 3: 93-8(July 1961). (In German)

The magnetic secondary effects of iron with 3% silicon permits a study of the production and diffusion of vacancies. Without irradiation, these investigations must be carried out over a long period of time. In addition to the thermal vacancies, other vacancies are produced by irradiation in a reactor. Over 400°C the thermal vacancies predominate, and the self-diffusion constant shows the usual increase with temperature. Under 400°C, the vacancies produced by the radiation effects predominate. An equilibrium exists between production and annihilation of the vacancies which leads to a temperature independent self-diffusion constant. Under 280°C the self-diffusion constant decreases since here the equilibrium between production and recovery is still not established. (tr-auth)

31279 DISLOCATION LOOPS AND HARDENING IN NEUTRON IRRADIATED COPPER. M. J. Makin, A. D. Whapham, and F. J. Minter (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phil. Mag. (8), 6: 465-8(Mar. 1961). (AERE-R-3523)

Experiments were undertaken to investigate the nature of dislocation loops in copper and the relation between the loops and the irradiation hardening. Foils of 99.998% copper were irradiated and subsequently electropolished. The distribution of the number of loops as a function of diameter after various neutron doses was determined. It was concluded that the loops expand by emitting vacancies and

must therefore be interstitial in character. Results also suggested that small defects may be responsible for a large part of the hardening. (M.C.G.)

31280 PRECIPITATION AND IRRADIATION HARDENING IN IRON. D. Hull and I. L. Mogford (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phil. Mag. (8), 6: 535-46(Apr. 1961). (AERE-R-3534)

Precipitation of carbon from α-iron during irradiation and thermal aging was studied using thin film electron transmission microscopy. During irradiation at 100°C precipitates formed with a density of 2×10^{14} cm^{-3} and saturated at 400 Å diameter after 72 hours in a flux of 1.5×10^{11} neutron cm^{-2} sec^{-1} > 1 Mev. The precipitates were in the form of plates parallel to {100} and occurred individually in the matrix and in rows on dislocation lines. Thermal aging at 100°C produced clusters of plates with a density of 3×10^{13} cm^{-3} and rows of plates on dislocation lines. At higher aging temperatures the plate-like precipitates were replaced by larger dendritic particles at 200°C and needle-shape particles at 250°C with a density of 3×10^{12} cm^{-3}. The defects produced during irradiation, which are responsible for irradiation hardening, were not detected. Tensile experiments showed that the hardening was most pronounced when precipitation did not occur. (auth)

31281 SPIN RESONANCE IN NEUTRON-IRRADIATED GRAPHITE. K. A. Müller (Battelle Memorial Inst., Geneva). Phys. Rev., 123: 1550-2(Sept. 1, 1961).

The carrier spin-resonance line of neutron-irradiated single crystals of graphite at 300°K was observed as a function of the thermal neutron flux up to a dose of 9.6×10^{18} nvt. From the intensity increase and the g shift for H parallel to the c axis, it is concluded that on the average 30 holes become mobile per nvt per cm^3. This is in agreement with earlier work of Hennig and Hove which was based on electrical measurements. It is shown that the line they reported in spin-resonance experiments on polycrystalline graphite was due to mobile charge carriers and not to paramagnetic carbon centers as they assumed. The number of holes created is compared to a recent electron transmission microscopy investigation of Bollmann where the damage was observed directly. It is estimated that about one hole per displaced carbon atom is freed. For the unirradiated graphite the linewidth was found to be anisotropic, being 4.6 gauss for H parallel and 3.0 gauss for H perpendicular to the c axis. This shows for the first time an incomplete "motional" narrowing for mobile carrier spin resonance. The anisotropy as well as the width decreases monotonically with irradiation, and at the highest dose investigated the linewidth is isotropic and equal to 1.3 gauss. The change in linewidth with irradiation and temperature is interpreted as due to a change in spin lattice relaxation time T_1 which is caused by carrier scattering via spin-orbit interaction. (auth)

31282 INVESTIGATION OF LOW-TEMPERATURE ULTRASONIC ABSORPTION IN FAST-NEUTRON IRRADIATED SiO_2 GLASS. R. E. Strakna (U. S. Naval Ordnance Lab., White Oak, Md. and Univ. of Connecticut, Storrs). Phys. Rev., 123: 2020-6(Sept. 15, 1961).

Ultrasonic attenuation measurements were made in normal and fast-neutron-irradiated fused silica at 7 to 50 Mc/sec and at 1.5 to 200°K. A broad attenuation curve, attributed to a structural relaxation with a distribution of activation energies, occurs at low temperatures. The shape of the loss curve is dependent upon the distribution of activation energies and the amplitude is proportional to the number of structural units which contribute to the relaxation process. Heavy fast-neutron irradiation produced no change in the shape of the curve while the amplitude decreased markedly. A loss associated with a specific defect, an elongated Si–O–Si bond with two equilibrium positions for the bridging oxygen atom, is consistent with the results of this study. The presence of a large number of these defects suggests a new concept of the structure of glass. Evidence is presented to show that thermal spikes, rather than displacement collisions alone, are responsible for the fast-neutron damage in SiO_2. (auth)

31283 STUDY OF THE EFFECT OF X- AND GAMMA-RAYS ON THE ABSORPTION AND EXCITATION SPECTRA OF NaCl + AgCl, NaCl + TlCl AND NaCl + $CuCl_2$ SINGLE CRYSTALS. A. Kh. Khalilov and A. P. Mamedov. Trudy Inst. Fiz., Akad. Nauk Azerbaidzhan. S.S.R., 10: 34-40 (1960). (In Russian)

Crystalline phosphors prepared of alkaline halide single crystals are useful for investigating the effect of the type and distribution of capture centers on the optical properties. Such a study was carried out by examining the absorption and excitation spectra of crystals irradiated with x-rays and gamma rays. Selective luminescence bands were formed by the stabilization of free electrons and voids on the capture centers in the lattice. The single crystals used had an activator concentration of 0.01 mole % and 1 mole %; a 50 kv and 10 milliamp W tube and a 2.5-curie Co^{60} source were used for the irradiation tests. Unexcited single crystals of NaCl did not show an absorption maximum. Three of the absorption maxima of the crystals containing the activator were present also in the pure crystals but in addition the following new absorption bands were found: for NaCl + Ag – λ_{max} = 280, 305, 325 mμ; for NaCl + Cu – 213, 235, 290 and 335 mμ; for NaCl + Tl – 235 and 280 mμ. (TTT)

31284 THE EFFECT OF X- AND GAMMA-RAYS ON THE ABSORPTION AND EXCITATION SPECTRA ON KCl + TlCl, KCl + $CuCl_2$ AND KCl + AgCl SINGLE CRYSTALS. A. Kh. Khalilov and E. Yu. Salaev. Trudy Inst. Fiz., Akad. Nauk Azerbaidzhan. S.S.R., 10: 44-51(1960). (In Russian)

While absorption spectra of KCl crystals activated with Tl, Cu and Ag admixtures have been investigated by several authors, the data do not agree well; in addition, the excitation spectra are insufficiently known. For these reasons the action of x- and γ-rays on the visible and ultraviolet luminescence spectra of these monocrystalline phosphors was further studied, comparing the spectra of the base and of the excited states. A 45-kv, 10-milliamp W tube and a 2.5-curie Co^{60} source were used for the irradiation tests which indicated the formation of supplementary absorption bands with the following maxima: 218, 230, 292, 323, 348, 440, 563 and 825 mμ for KCl + AgCl; 217, 235, 251, 282, 563 and 825 mμ for KCl + TlCl; 218, 235, 255, 290, 355, 825 and 563 (sic) mμ for KCl + $CuCl_2$. The admixtures exert an effect on the capture probability of electrons and voids by microdefects in the KCl lattice. In the KCl + $CuCl_2$ excitation spectrum the intensity of the ultraviolet luminescence is higher than that of the visible luminescence. (TTT)

31285 EFFECT OF THE IONIZING RADIATION OF A FLOW OF ACCELERATED ELECTRONS ON THE CATION EXCHANGER KU-2. [PART] I. E. D. Kiseleva, K. V. Chmutov, and V. N. Krupnova (Inst. of Physical Chemistry, Academy of Sciences, USSR). Zhur. Fiz. Khim., 35: 1816-21(Aug. 1961). (In Russian)

A study of the effect of radiation from an electron beam on the cation exchanger KU-2 in air shows that this leads to a fall in swelling and in the exchange capacity with re-

spect to the SO_3H group. New exchange groups appear in the resin, with apparent dissociation constants of pK = 4.4 and 7.3. The exchanger partially breaks down, passing over to the soluble state. (auth)

31286 EFFECT OF THE IONIZING RADIATION OF A FLOW OF ACCELERATED ELECTRONS ON THE CATION EXCHANGER KU-2. II. IRRADIATION OF KU-2 IN AQUEOUS ACID SOLUTIONS AND IN BI-DISTILLATE. E. D. Kiseleva, K. V. Chmutov, and V. N. Krupnova (Inst. of Physical Chemistry, Academy of Sciences, USSR). Zhur. Fiz. Khim., 35: 1822-7(Aug. 1961). (In Russian)

The action of an electron beam on the cation exchanger KU-2 in aqueous acid (nitric, lactic, acetic) solutions and in bi-distillate was investigated. It is shown that irradiation of Ku-2 by doses of 0.005 to 1.6×10^{23} ev/g leads to weight loss, diminishing exchange capacity, and change in swelling. Under the given experimental conditions new exchange groups of the phenolic or carboxylic type appear in the irradiation process. The amount of new groups is highest on irradiation in water. The change in swelling is shown to differ on irradiation in bi-distillate and in acid solutions. (auth)

31287 METHOD OF OPPOSING IRRADIATION-INDUCED VISCOSITY INCREASE IN EMPLOYMENT OF ORGANIC FLUIDS. Robert O. Balt (to U. S. Atomic Energy Commission). U. S. Patent 3,005,760. Oct. 24, 1961.

A method is described for conducting mechanical operations necessitating the use of a lubricant in a medium subject to reactor irradiation of 0.5×10^{12} to 1×10^{12} neutrons/cm^2/sec. A thiopolyether lubricant such as 16, 19-dioxa-13, 22-dithiatetratriacontane is used. (AEC)

PHYSICS

General and Miscellaneous

31288 (61GL164) OPTIMIZATION CALCULATIONS FOR FUEL CELL SYSTEMS. Jon Van Winkle and W. N. Carson, Jr. (General Electric Co. General Engineering Lab., Schenectady, N. Y.). Sept. 7, 1961. 27p.

A method for combining the characteristics of application, fuel supply, and fuel cell so as to determine the design point for the desired minimum is outlined. The procedure consists of formulating the total system size in terms of the cell operating voltage and determining the value of the cell voltage which makes the total a minimum. It is entirely general for fuel cell systems regardless of their specific characteristics or of the fuel and oxidant combination used. It provides the theoretical derivation for the figure of merit commonly used for fuel cells and generalizes this figure of merit for the total system in a particular application. (auth)

31289 (AD-255294) DIRECT ENERGY CONVERSION LITERATURE ABSTRACTS. (Naval Research Lab., Washington, D. C.). Mar. 1961. 120p.

An annotated bibliography is presented consisting of 547 references on direct conversion. The material is arranged according to: energy conversion; thermoelectricity; thermionic emission; photoelectric processes; magnetohydrodynamics; electrochemical processes; and energy sources. An author index is included. (B.O.G.)

31290 (AFOSR-2313) IRREDUCIBLE REPRESENTATIONS OF MAGNETIC GROUPS. J. O. Dimmock and R. G. Wheeler (Yale Univ., New Haven. Sloane Physics Lab.). July 19, 1961. Contract AF49(638)-503. 50p.

The general considerations of Wigner concerning the irreducible representations of groups containing both linear and anti-linear unitary operators are used to obtain a criterion by which the representations of such groups may be obtained. The result found by Herring for space groups is derived and the properties of the 58 magnetic point groups are determined. (auth)

31291 (AFOSR-TN-1392) FINE STRUCTURE IN THE ABSORPTION EDGE OF THE SILVER HALIDES. Technical Note No. 6. F. C. Brown, T. Masumi, and H. H. Tippins (Illinois. Univ., Urbana). Aug. 1961. Contract AF49(638)-579. 20p.

The results of optical absorption measurements on pure AgCl and AgBr are reported and compared with the wavelength dependence of photoconductivity in these materials. Detailed structure consisting of low level absorption-tails and several shoulders was found at various temperatures down to 4.2°K. The data were analyzed in terms of indirect optical transitions together with a plausible band structure and vibration spectrum. (auth)

31292 (AFOSR-TN-1393) RECOMBINATION OF ELECTRONS AND DONORS IN SEMICONDUCTORS. Technical Note No. 7. G. Ascarelli (Illinois. Univ., Urbana) and S. Rodriguez (Purdue Univ., Lafayette, Ind.). Aug. 1961. Contract AF49(638)-579. 18p.

A description is given of a calculation of the recombination of electrons in the conduction band of a semiconductor with ionized donor impurities. It was assumed that the process consists in the initial capture of the electron in an excited state of the donor center followed by a transition to the ground state. This mechanism was most effective in the case in which all transitions are accompanied with emission or absorption of phonons. The results obtained were compared with earlier theoretical calculations and with experiments. (auth)

31293 (ANL-6391) PHYSICS DIVISION SUMMARY REPORT, JULY–AUGUST 1961. (Argonne National Lab., Ill.). Contract W-31-109-Eng-38. 48p.

Experimental Nuclear Physics. The theory of a simple magnetic bunching system for producing pulsed beams was studied for the case where the deflection voltage is sinusoidal, the magnetic field is uniform, and the fringing field produces a two-dimensional focus. Effects limiting the bunching are treated. The design, operation, and performance of an apparatus for resonance absorption (Mössbauer) measurements are discussed. The gamma spectrum of La^{135} decay was measured both alone and in coincidence, and the lower limit of the ratio of K capture to β^+ emission to the ground state was determined to be 5000. Theoretical Physics. The 15.1-Mev level of C^{12} is discussed with respect to inelastic scattering of protons on C^{12}. Equations were developed correlating the proton scattering to the nucleon-nucleon interaction. Wave functions are derived for nuclei in which the $1f_{\frac{1}{2}}$ level is filling with neutrons and protons, and properties are calculated for these nuclei and compared with experimental values. (D.L.C.)

31294 (APAE-98) DESIGN CRITERIA FOR IRRADIATED VESSELS; TASK 6.8 SUMMARY REPORT. D. W. McLaughlin (Alco Products Inc., Schenectady, N. Y.). Sept. 29, 1961. Contract AT(30-1)-2639. 20p.

Design criteria to prevent the brittle fracture of ferritic reactor vessels that could occur as a result of the rise in NDT caused by fast neutron irradiation are presented. The criteria require that maximum principal stress in the vessel does not exceed 18% of yield stress at temperatures below NDT + 60°F. Under certain conditions the allowable stress may be based on the irradiated yield stress. A discussion of brittle fracture and an explanation of the criteria are included. (auth)

31295 (ARF-3184-10) SCAVENGING OF RADIOACTIVE AEROSOLS IN CONNECTION WITH NUCLEAR-POWERED SHIPS. J. Rosinski and J. Stockham (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Aug. 10, 1961. Contract AT(11-1)-578. 8p.

A McBain-Bakr sorption balance was constructed and calibrated for sorptive studies of active carbons for iodine vapor. Experiments on dispersion of oil as smoke are reported. (D.L.C.)

31296 (CERN-61-22) INTERNATIONAL CONFERENCE ON THEORETICAL ASPECTS OF VERY HIGH-ENERGY PHENOMENA, SPONSORED BY THE INTERNATIONAL UNION OF PURE AND APPLIED PHYSICS (IUPAP), HELD AT CERN, JUNE 5–9, 1961. J. S. Bell, F. Cerulus, T. Ericson, J. Nilsson, and H. Rollnik, eds. (European Organization for Nuclear Research, Geneva). Aug. 11, 1961. 431p.

Included are 35 papers, a summary of a paper, and a summary report of the conference on high-energy phenomena. The papers are presented in sections discussing weak interactions, electromagnetic interactions, experimental results, statistical models, diffraction theory, one-meson exchange, dispersion theory and Mandelstam representation, and accelerators. Separate abstracts have been pre-

pared for the 35 papers and the conference summary. (B.O.G.)

31297 (CERN-61-22(p.7-28)) SOME TOPICS IN THE THEORY OF WEAK INTERACTIONS. S. M. Berman (European Organization for Nuclear Research, Geneva).

Discussions are given of neutrino-induced events in the region of 1 Bev, which include: effects of the exclusion principle on the cross section for $\nu + n \rightarrow p + e(\mu)$, and $\bar{\nu} + p \rightarrow n + e(\mu)$; strange-particle and single-pion production; and electron-neutron scattering, $\nu + e \rightarrow \nu + e$. Remarks are made for higher energy reactions for: second order processes in the weak coupling constant; neutrino charge form factors; and the possibility of using muons in weak interaction experiments. (B.O.G.)

31298 (CERN-61-22(p.29-43)) FORBIDDEN WEAK INTERACTION PROCESSES. J. Nilsson and R. E. Marshak (European Organization for Nuclear Research, Geneva).

A discussion is presented of allowed and forbidden processes occurring in weak interactions, and Feynman diagrams are included to elucidate the processes. The detection of the low-energy processes depends on the magnitude of the cut-off energy to which the virtual weak interaction matrix elements may be taken valid. Considerations are given for some forbidden strange particle processes at low energies, and the possibility of detecting forbidden processes in any high-energy experiments. It is concluded that for the most favorable circumstances, for coherence and relative energy of μ and e of the order of several hundred Bev, the cross sections for forbidden weak processes will not exceed 10^{-40} cm^2. (B.O.G.)

31299 (CERN-61-22(p.44-7)) THEORETICAL CONSIDERATIONS ON W-PRODUCTION BY "HIGH"-ENERGY NEUTRINOS. T. D. Lee (Institute for Advanced Study, Princeton, N. J.).

The considerations are discussed for boson production by high-energy neutrinos for coherent processes: $\nu + Z \rightarrow W^+ + \mu^- + Z$, and incoherent processes: $\nu + Z \rightarrow W^+ + \mu^- + Z^*$, where W is the boson, and Z denotes a nucleus of charge Z. The cross sections for $W^{\pm}$ production, averaged over neutrinos of different energies, for various boson masses were calculated for iron and the results are shown graphically. (B.O.G.)

31300 (CERN-61-22(p.48-53)) THE CERN NEUTRINO PROJECT. G. Bernardini (European Organization for Nuclear Research, Geneva).

A discussion is presented of the status of the CERN neutrino research carried out by the proton synchrotron staff, the Ecole Polytechnique group for the heavy liquid bubble chamber, the CERN bubble chamber group, and the CERN cloud chamber and counters group. (B.O.G.)

31301 (CERN-61-22(p.57-66)) COLLIDING BEAMS EXPERIMENT. Burton Richter (Stanford Univ., Calif.).

A discussion is given of the characteristics of the beam of the linear accelerator, and the status of construction of the various components to be used in the colliding-beam experiments. Difficulties in developments for the positron experiments are described. (B.O.G.)

31302 (CERN-61-22(p.67-74)) THE FRASCATI STORAGE RINGS. B. Touschek (Rome. Università. Istituto di Fisica).

Developments are described for the design and construction of two storage rings, designated AdA and Adone, for electrons and positrons at energies to 250 and 1500 Mev, respectively. Preliminary tests with the AdA allowed rough values to be obtained for some of the parameters defining the positions of various component parts of the machine; and showed that the machine could be displaced without disturbing the stored particles, that the magnetic field could be changed at will without loss, that there is no difference within the accuracy of the measurements between electrons and positrons, and that the capture efficiency was smaller than that calculated based on statistical theory. (B.O.G.)

31303 (CERN-61-22(p.75-98)) ELECTRON-POSITRON COLLIDING BEAM EXPERIMENTS. R. Gatto (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati).

A discussion is given of work done on the Adone project to produce high-energy colliding beams of electrons and positrons, in terms of: general considerations and radiative corrections for the one-photon channel; K-meson and multiple π-meson production in annihilation reactions; $e^+ + e^- \rightarrow \pi^0 + \gamma$ reactions; production of resonances in the annihilation reactions; baryon pair production; vector meson production; limitations from unitarity for the one-photon channel; relations between the annihilation cross section into strong interacting particles and modifications of the photon propagator; and production of intermediate charged vector mesons in weak interactions. (B.O.G.)

31304 (CERN-61-22(p.99-124)) THE MAIN FEATURES OF NUCLEAR INTERACTIONS ABOVE 100 GeV. D. H. Perkins (Bristol Univ., England. H. H. Willis Lab.).

The characteristics of nucleon-nucleon interactions at energies to 10^2 Bev are discussed in connection with the differential energy spectra of cosmic rays. The discussion is given in terms of total inelastic cross sections for collisions with nuclei, the attenuation length of shower producing radiation, the multiplicity of charged secondary relativistic particles, differential cross sections for production of different particle types, energy distribution of π-mesons in the c.m. system, angular distributions in the c.m. system, and transverse momentum in high-energy collisions, inelasticity of the collisions. A summary is included of the results for the phenomenological models. A description is given of the observations of new processes in nuclear interactions at high energies. Discussions are included of experimental techniques used to study high-energy interactions in cosmic radiation. (B.O.G.)

31305 (CERN-61-22(p.125-7)) TWO ANOMALOUS EVENTS. P. H. Fowler (Bristol Univ., England).

A discussion is given of the detection and measurement of two anomalous events in W-em emulsion sandwich stacks. The stacks, having a density of 12 g/cc, were exposed for 250 hr at 220 g/cm^2. Incident on the stacks were 20 γ rays and nuclear-active particles, which produced cascades that were parallel as far as could be measured. Plates are included showing the development of the events at 1.5 to 16.5 radiation lengths in the emulsion. (B.O.G.)

31306 (CERN-61-22(p.128-44)) EXPERIMENTAL RESULTS OBTAINED WITH THE 25 GeV CERN ACCELERATOR. G. Cocconi (European Organization for Nuclear Research, Geneva).

The experimental results obtained for strong interactions at very high energies are discussed for analyses of interactions of 16-Bev π^--mesons in the 30-cm hydrogen bubble chamber, interactions of 24-Bev protons in the bubble chamber, and counter studies of the scattering of 10- to 26-Bev protons. (B.O.G.)

31307 (CERN-61-22(p.145-50)) RECENT EXPERIMENTAL RESULTS ON HIGH-ENERGY TOTAL CROSS-

SECTIONS. K. Winter (European Organization for Nuclear Research, Geneva).

A review is presented of measurements of total cross sections for $(\pi^{\pm},p)$, $(K^{\pm},p)$, $(\bar{p},p)$, and (p,p) reactions, at energies to 28 Bev/c. Measurements of the total attenuation cross section of gamma rays were made with carbon and hydrogen at 10 Bev, and lithium, carbon, copper, and lead at 13.5 Bev, which resulted in agreement with theoretical values within the experimental errors of 2 to 3%. (B.O.G.)

31308 (CERN-61-22(p.151-2)) COMMENT ON WINTER'S REPORT ON $\sigma^{\pm}$ (THE TOTAL CROSS-SECTIONS FOR $\pi^{\pm}$-p) AT HIGH ENERGIES. J. G. Hamilton (London. Univ. University Coll.).

A derivation is given of the sum rule obtained from Goldberger's dispersion relations for forward scattering of $\pi^{\pm}$ of energy ω on protons, and the effects of the von Dardel group results on the sum rule for: $\sigma_{-}(\omega) - \sigma_{+}(\omega) = 2$ mb for 2 Bev $\leq \omega \leq$ 20 Bev. (B.O.G.)

31309 (CERN-61-22(p.153-65)) ELASTIC AND QUASI-ELASTIC INTERACTIONS OF 24 GeV PROTONS AND 16 GeV NEGATIVE PIONS IN HYDROGEN. D. R. O. Morrison (European Organization for Nuclear Research, Geneva).

The elastic and quasi-elastic interactions studies are discussed for elastic p-p interactions at 24 Bev, inelastic two-prong events in 24-Bev p-p interactions, inelastic two-prong events in 16-Bev/c π^{-}-p interactions, and average transverse momentum in elastic and inelastic p-p and π^{-}-p events at 270 to 377 Mev/c. (B.O.G.)

31310 (CERN-61-22(p.166-70)) SUMMARY OF EXPERIMENTAL DATA CONCERNING THE "TWO CENTRES MODEL." M. Miesowicz (Uniwersytet Jagiellonski, Krakow. Fizyczny Instytut).

The experimental data for the models are discussed for cosmic-ray jets produced by single charged or neutral particles at energy $E > 10^{12}$ ev. Observations of the jets showed that the anisotropy (σ) of the jets increases in the increasing primary energy, and the spread of σ values for individual jets is very large. The discussion is limited to jets with $N_h \leq 5$ and $n_s < 20$, where N_h is the number of evaporation tracks and n_s is the number of shower particles. The results are summarized by showing that there is a correlation of three characteristics of the jets: double maximum distribution, small multiplicity (n_s), and large anisotropy (σ). (B.O.G.)

31311 (CERN-61-22(p.171-4)) SOME REMARKS ABOUT TWO-MAXIMA ANGULAR DISTRIBUTIONS IN JETS. J. Gierula (Uniwersytet Jagiellonski, Krakow. Fizyczny Instytut).

A discussion is given of anisotropies realized from the angular distributions of secondary particles emitted isotropically from two centers moving in opposite directions in the c.m. system of colliding nucleons in jets. The two-center model gives a description of the angular distribution, and predicts some correlations of other jet characteristics. An equation is given showing the correlations taken from energy conservation laws. (B.O.G.)

31312 (CERN-61-22(p.175-9)) PRODUCTION OF HYPERONS IN π-p COLLISIONS. J. D. Dowell, B. Leontic, A. Lundby, R. Meunier, G. Petmezas, J. P. Stroot, and M. Szeptycka (European Organization for Nuclear Research, Geneva).

An investigation was made of the production of hyperons in collisions between π^{-}-mesons of 1- to 5-Bev/c momentum at intensities of 2 to 6×10^5 per burst with a liquid hydrogen target: $\pi^{-} + p \rightarrow K^{+} + Y^{-}$, where Y is the hyperon. Preliminary measurements made in which K^{+}-mesons of 0.9- to 1.5-Bev/c momentum were selected, resulted in production cross sections for Y^{1}_{-1} of 0.1 mb/steradian at 0° in the laboratory system with primary π^{-}'s at 1.8-Bev/c momentum. (B.O.G.)

31313 (CERN-61-22(p.183-204)) LIMITATION OF THE DESCRIPTION OF STRONG INTERACTIONS BY CENTRAL COLLISIONS AND THE STATISTICAL MODEL. R. Hagedorn (European Organization for Nuclear Research, Geneva).

An outline is given of the statistical theory used at CERN along with a discussion of other versions of the theory to point out the successes and failures of the theory. Limitations resulting from the theory are described for the nature of possible predictions, applicability, and computational difficulties. Conclusions are described for present developments in the statistical theory. (B.O.G.)

31314 (CERN-61-22(p.205-11)) A NEW METHOD TO EVALUATE PHASE SPACE INTEGRALS WITH SPECIAL APPLICATION TO ANGULAR MOMENTUM EFFECTS. T. Ericson (European Organization for Nuclear Research, Geneva).

An outline is given of an approximation technique for use in the evaluation of phase-space integrals, and which becomes asymptotically exact for large multiplicities. The method has the additional advantage that it can be generalized to permit the incorporation of the angular momentum conservation in the statistical model. (B.O.G.)

31315 (CERN-61-22(p.212-20)) ANGULAR MOMENTUM CONSERVATION IN STATISTICAL THEORIES. F. Cerulus (Institut Interuniversitaire des Sciences Nucléaires, Brussels and European Organization for Nuclear Research, Geneva).

An outline is presented of a formulation of a statistical theory for multiple meson production for the probability that the creation of n particles in the end states is proportional to the probability of finding the particles in a volume the size of which is of the order of the range of the strong interactions. (B.O.G.)

31316 (CERN-61-22(p.221-50)) STATISTICAL DYNAMICS OF MULTIPLE MESON PRODUCTION. E. C. G. Sudarshan (Rochester, N. Y. Univ.)

A statistical postulate is formulated from conservation laws of energy, momentum, and isotopic spin of equal probability for all allowed configurations, thus yielding explicit formulas for the unnormalized spectra involving the phase-space integrals. The qualitative features of the statistical theory are outlined for a review of experimental data on multiple processes. A discussion is given of testing the statistical model by comparing the predicted and experimental total cross sections as a function of the energy in connection with partial wave analyses of π-N and N-N reactions. An application of the statistical theory is studied in the multiple production of mesons in antinucleon annihilation. Calculations in progress are described for the model using the multiplicity, angular correlations, and effective mass distributions as a method of finding evidence for the π-π interactions and to determine its nature. (B.O.G.)

31317 (CERN-61-22(p.253-8)) ELASTIC πN SCATTERING. D. I. Blokhintsev, V. S. Barashenkov, Wang Yung, E. K. Mihul, Tzu-tzan Huang, and Shih-ko Hu (Joint Inst. for Nuclear Research, Dubna, U.S.S.R.).

An analysis was made of experimental data on π-N

scattering by means of dispersion relations. The applicability of the equation for calculating the pion absorption coefficient in a nucleon is discussed. An analysis of the π-N scattering is described on the basis of the S-matrix for determining the spatial nucleon structure. The determination of the effective potential of π-N interactions from experimental data is discussed. (B.O.G.)

31318 (CERN-61-22(p.259-62)) PROTON-ANTIPROTON ANNIHILATION ABOVE 1 GEV. Maurice Lévy (Paris. Université, Orsay. Ecole Normale Supérieure. Laboratoire de Physique Théorique et Hautes Energies).

A discussion is given of a generalization of a minimum theorem for p-$\bar{p}$ annihilation above 1 Bev for the separation of the values of R and R_0, the radii of the region of inelasticity. From the values determined for R, 1.0×10^{-13} cm at 4 Bev/c and 0.90×10^{-13} cm at 6 Bev/c, the annihilation region appears to be much larger than should be expected from meson theory. (B.O.G.)

31319 (CERN-61-22(p.263-71)) THE PHENOMENON OF DIFFRACTION DISSOCIATION. M. L. Good (Wisconsin. Univ., Madison).

A kinematic discussion is given of the existence of a type of low momentum transfer collision from a consideration of a collision of a particle of mass M with a nucleus in which the particle transforms into a system of mass M* as a result of the collision. The process is related to conventional ideas involving single meson-π exchange. Preliminary data are discussed for a study of the process in which the hoped-for reaction is: $\pi^- + C^{12} \rightarrow (\pi^- + \pi^- + \pi^+) + C^{12}$, at $p_\pi \simeq 4.5$ Bev/c. (B.O.G.)

31320 (CERN-61-22(p.272-9)) REMARKS ON THE "QUASI-ELASTIC" DIFFRACTION SCATTERING OF HIGH-ENERGY PROTONS. B. T. Feld (European Organization for Nuclear Research, Geneva and Massachusetts Inst. of Tech., Cambridge).

A discussion is given assuming that earlier observations correspond to the quasi-elastic excitation of the two $T = \frac{1}{2}$ nuclear isobars observed in π-N scattering, which is perhaps contradictory or complementary to the one-pion exchange process. (B.O.G.)

31321 (CERN-61-22(p.283-95)) SINGLE-PARTICLE-EXCHANGE MODEL OF HIGH ENERGY INELASTIC COLLISIONS. Freda Salzman and George Salzman (Colorado. Univ., Boulder).

A review is given of features of the single virtual particle exchange model for inelastic collisions, which is obtained as a generalization of the elastic scattering case. The effects of replacing the strong condition, which holds for elastic scattering, with a weaker condition in the inelastic collision case are discussed. Several aspects are described which involve the expression for the cross section obtained in the model. A discussion is included of the extreme high-energy limit of the model in the case of N-N collisions. An investigation is described which shows that the model taken together with the asymptotic assumptions probably violates unitarity. A single pion exchange process is described in which it is possible for almost all of the energy of a high-energy pion to be converted into a single photon produced at almost zero energy with respect to the incident pion. (B.O.G.)

31322 (CERN-61-22(p.297-307)) QUASI-ELASTIC SCATTERING OF HIGH-ENERGY PROTONS IN THE ONE-PION-EXCHANGE MODEL. F. Selleri and E. Ferrari (European Organization for Nuclear Research, Geneva).

A discussion is given suggesting a method for calculating the complete one-pion-exchange contributions by neglecting only the form factor corrections for the nucleon, related to a function of the squared 4-momentum of the exchanged pion. The various items introduced in the method are described in terms of: a definition of the pionic form factor of the nucleon; an argument for off-shell π-N scattering; and the possible use of quasi-elastic p-p scattering for determining the pionic form factor. (B.O.G.)

31323 (CERN-61-22(p.308-19)) PERIPHERAL COLLISIONS. M. Baker (Stanford Univ., Calif.).

Two problems are discussed which relate to one-meson-exchange process. The first is the analysis of experiments on quasi-elastic p-p scattering, the characteristic feature of which is the appearance of an inelastic peak at 1 Bev from the elastic peak independent of an inelastic energy of the scattering angle. The other is the analysis of the possibility of determining the pion form factor by the high-energy production of π-mesons by electrons, in the reaction: $e^- + p \rightarrow e^- + p + \pi^- + ?^+$. (B.O.G.)

31324 (CERN-61-22(p.320-7)) INELASTIC πN COLLISIONS. D. I. Blokhintsev, V. S. Barashenkov, Wang Yung, E. K. Mihul, Tzu-tzan Huang, and Schi-kei Hu (Joint Inst. for Nuclear Research, Dubna, U.S.S.R.).

A discussion is given of a scheme of calculations based on the one-meson-π mechanism of momentum transfer from a meson-π to a nucleon. Diagrams are included showing that for even meson-π production the process takes place in peripheral collisions, while of odd meson-π production, the process occurs during the scattering of a virtual meson-π on a nucleon. To calculate the relative multiplicity of meson-π, momentum transfer, and the angular distributions, the partial cross sections for π-π interactions are required. Conclusions drawn from the calculations were that the one-meson-π mechanism and the π-π interactions are important and predominant in the π-N interactions, and that the central collisions do not seem to be significant. (B.O.G.)

31325 (CERN-61-22(p.331-42)) A UNIFIED DYNAMICAL APPROACH TO HIGH- AND LOW-ENERGY STRONG INTERACTIONS. S. C. Frautschi (California. Univ., Berkeley. Lawrence Radiation Lab.). (UCRL-9728)

A discussion is presented of work conducted on low-energy scattering, forward dispersion relations and peripheral contributions to high-energy, low-mementum transfer scattering, in which the region of application is enlarged, and the dynamics of high- and low-energy strong interactions are treated in a unified way. General consequences of the Mandelstam representation are discussed to understand low-energy scattering potential. The strip approximation is discussed which is introduced to the extent that the generalized one-meson-π potential can be calculated. The asymptotic behavior and oscillations in the strip directions are described for the occurrence of forward-diffraction peaks in the physical regions of high energies and low-momentum transfers near the strip. An outline is included of investigations proposed or in progress for: computer calculations of the spectral functions generated by iteration of a non-relativistic Yukawa potential; a calculation of adiabatic π-π scattering for increasing values of the interaction parameter, λ; and the application of analogous methods to π-N, and N-N scattering. (B.O.G.)

31326 (CERN-61-22(p.343-52)) A THEORETICAL APPROACH TO HIGH ENERGY SCATTERING. D. Amati and S. Fubini (European Organization for Nuclear Research, Geneva).

Theoretical considerations are given for understanding the regularities occurring in high-energy processes for which some properties may be predicted. The properties were: the shape of the diffraction peak, including its width, is independent of the process; for some Bev energies in the c.m. system the diffraction peak is predicted by an equation which contains no other parameter besides the meson-π mass; and justification of a one-boson-exchange formula for total cross sections. A discussion is included of the validity of using the peripheral picture found for total cross sections for determining partial inelastic cross sections. (B.O.G.)

31327 (CERN-61-22(p.353-65)) APPLICATION OF MANDELSTAM REPRESENTATION TO PERIPHERAL COLLISION. C. Goebel (Rochester, N. Y. Univ.).

The Mandelstam representation was applied in the nearby strip approximation to high-energy diffraction scattering in NN and πN interactions. Conclusions reached from the application were: that a large part of the NN interactions must come from virtual πN collisions occurring at long range; that the exchange of mesons between the π's and between the π and N must be considered in the interactions; and that a "chain-of-pions" may be of importance in the interactions. Consequences which were found to be fairly clear were: that the energy available in the collisions is fragmented into many lower energy π-π collisions, resulting in the observation of a smaller production of heavy particle pairs compared to π's; and that the inelastic angular distribution is such that the nucleons seem to be the particles with the highest momenta in the c.m. system. (B.O.G.)

31328 (CERN-61-22(p.366-9)) ON THE HIGH-ENERGY LIMIT OF SCATTERING AMPLITUDES. H. Lehmann (Hamburg. Universität. Institut fur Theoretische Physik).

A summary is presented of arguments relevant to the high-energy behavior of amplitudes proposed previously. A discussion is given of the expected asymptotic behavior of amplitudes referring to elastic scattering of two particles. It is concluded that if neither of the particles is self-conjugate, the given behavior of the real part is valid only if the difference of particle-particle and antiparticle-particle amplitudes satisfies in addition a sum-rule which is well known for forward scattering. (B.O.G.)

31329 CERN-61-22(p.370-5)) RANGE OF THE NUCLEON-ANTINUCLEON AND MANDELSTAM REPRESENTATION. A. Martin (European Organization for Nuclear Research, Geneva).

An analysis is made of a general scattering process supposed to satisfy the Mandelstam representation. An application is made of the treatment to the case of $N\bar{N}$ annihilation, in which two possible reactions compete: $\bar{N} + N \rightarrow \bar{N} + N$ and $\bar{N} + N \rightarrow n + \pi$. The extension of the arguments to energies above the meson production threshold is discussed. The present result is considered to be not incompatible with experimental data. (B.O.G.)

31330 (CERN-61-22(p.376-86)) ON ASYMPTOTIC BEHAVIOUR OF ANNIHILATION AND ELASTIC SCATTERING PROCESSES AT HIGH ENERGIES. V. N. Gribov and I. Ya. Pomeranchuk (Akademiya Nauk S.S.S.R.).

It is shown that the cross sections of a number of annihilation processes cannot decrease faster than a certain power of energy contradicting with the prediction of the statistical theory. This conclusion follows from the dispersion relations and from the assumption that the spectral functions do not increase faster than a power. This result depends essentially on the possibility or impossibility of the compensation of the momentum transfer pole term by the contributions from the cut. If the compensation does not occur, the cross sections of the processes are decreasing not faster than 1/E and the partial wave amplitudes with $l > p/m$ decrease exponentially, normal periphery. In this case one may expect a maximum in the differential cross section of the elastic π^+ and K^+ meson-proton scattering at the angles close to 180°. The value of the maximum does not tend to zero with increasing energy. On the other hand, the pole term compensation demands the phases with $l\ m/p \rightarrow \infty$ to play an important role and this involves rapid variations in the angular distribution. (auth)

31331 (CERN-61-22(p.389-403)) PROSPECTS AND PROBLEMS OF FUTURE ACCELERATOR PROJECTS. A. Schoch (European Organization for Nuclear Research, Geneva).

A review is presented of the problems encountered in developing facilities for producing high-energy phenomena. Two conceivable methods for achieving the phenomena are: extrapolation of present AGS designs, which would provide high-energy particle beams with beams of unstable secondary particles; and colliding beam experiments which provides only high-energy reactions between a limited number of stable particles. The use of cryogenic cooling and plasma devices for obtaining stronger magnetic fields is discussed. (B.O.G.)

31332 (CERN-61-22(p.407-23)) SUMMARY LECTURE [ON HIGH ENERGY PROPERTIES OF ELEMENTARY PARTICLES]. L. Van Hove (European Organization for Nuclear Research, Geneva).

A review is presented of the present situation concerning theoretical understanding of very high-energy phenomena for electromagnetic, strong, and weak interactions of elementary particles. (B.O.G.)

31333 (CEX-59-14) DETERMINATIONS OF AERODYNAMIC DRAG PARAMETERS OF SMALL IRREGULAR OBJECTS BY MEANS OF DROP TESTS. E. R. Fletcher, R. W. Albright, V. C. Goldizen, and I. G. Bowen (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). June 1960. 77p.

Drag coefficients were determined for various irregular objects such as glass fragments, stones, steel fragments, and spheres by means of drop tests for use in a mathematical model to correlate nuclear explosion blast experiments. Drop tests were also made on small laboratory animals and extrapolated to estimate the drag properties of man. A method was developed to estimate the average drag properties of man from his total surface area. (D.L.C.)

31334 (DOFL-TR-957) THE SURFACE STATES IN SOLIDS. A Literature Survey. Herman Shulman (Diamond Ordnance Fuze Labs., Washington, D. C.). Sept. 15, 1961. 34p.

A summary is given of the Tamm and the Shockley theories of the electronic structure at the surfaces of an ideal crystal. It is shown that the Tamm theory always predicts the presence of one additional electronic state, per surface atom, over and above those within the bulk energy bands; whereas the Shockley theory makes this prediction only under special circumstances. In the case of the elemental semiconductors that possess diamondlike lattices, germanium and silicon, it is seen that the two theories agree. Moreover, it is shown that an appreciation of the role of these states in semiconductors is essential whenever phenomena involving the surface are considered. A distinction is drawn between ideal and real (e.g., oxide-contaminated) surfaces, which leads to the concepts of "fast" states and

"slow" states. Some of the experimental techniques utilized in the investigation of the properties of semiconductor surfaces are reviewed, and the underlying theory is described. Special attention is given to the field-effect experiments of Shockley and Pearson on germanium, the results of which, together with those of the contact-potential measurements of Myerhoff on silicon, led Bardeen to recognize the essential role of surface states in these materials. The state of the science of semiconductor surfaces research is summarized, and some areas of possible future inquiry are pointed out. (auth)

31335 (EOS-1583(Final)) CESIUM ION-ATOM CHARGE EXCHANGE SCATTERING. Final Report, September 1, 1960–September 30, 1961. R. C. Speiser (Electro-Optical Systems, Inc., Pasadena, Calif.). Sept. 30, 1961. Contract NONR-3305(00). 26p.

The charge transfer cross section for cesium ions and atoms was measured as a function of interaction velocity in the range $v = 2 \times 10^6$ to $v = 1.2 \times 10^7$ cm/sec (300 ev to 10 kev). The measurements were made using crossed ion and atom beams with the atom beam chopped. The data fit a curve $\sigma^{1/2} = A - B \log (v/10^6 \text{ cm})$ with $A = 1.96 \times 10^{-7}$ cm and $B = 0.85 \times 10^{-7}$ cm. The general form of this curve is in agreement with theory although the constants do not agree closely with any theoretical calculation. The data were applied to the calculation of a limit of ion motor operation lifetimes. (auth)

31336 (IFA/DF-12) VISCOSITY OF BINARY MIXTURES OF ISOTOPES OF DIATOMIC GASES. D. Barb, V. Mercea, and A. Olariu (Academia R. P. R. Institutul de Fizică Atomică, Bucharest). 1961. 13p.

An approximate formula for the coefficient of viscosity of a binary mixture of isotopes of diatomic gases is derived, which is verified for molecules of the type A_2, AB, B_2. The results are compared with both the values computed with Hirschfelder's formulas as well as with the experimental data obtained by Itterbeek and co-workers. It is pointed out that the coefficient of viscosity depends, in the first approximation, only on the ratio of the two isotopes and is independent of their distribution between the molecular species. (auth)

31337 (IFA/M-23) PLANE MODELS FOR CYLINDRICALLY SYMMETRIC MAGNETIC FIELDS. C. C. Iliescu (Academia R. P. R. Institutul de Fizica Atomica, Bucharest). Mar. 29, 1961. 6p.

Expressions for the magnetic scalar potential, the magnetic induction field components, and the pole face shape are derived in the case of plane symmetric fields and compared with those valid for cylindrically symmetric fields. (L.T.W.)

31338 (LAMS-2567) THE PARTICLE-AND-FORCE COMPUTING METHOD FOR FLUID DYNAMICS. Francis H. Harlow and Billy D. Meixner (Los Alamos Scientific Lab., N. Mex.). June 1961. Contract W-7405-ENG-36. 49p.

A fluid-dynamic computing method is proposed in which the materials are represented by discrete particles interacting with one another by means of pair forces. Details of technique, accuracy, and stability are discussed in preliminary form. Results are presented of some simple tests of the method, and it is shown that even though considerable development effort is yet required, the method appears to have some desirable properties not present in any other. (auth)

31339 (NP-10528) QUARTERLY PROGRESS REPORT NO. 41 [ON SOLID STATES PHYSICS]. (Massachusetts Inst. of Tech., Cambridge. Solid-State and Molecular Theory Group). July 15, 1961. Contract Nonr-1841(34). 94p.

Calculations are described of: the Fermi surfaces of Cu; self-consistent-field (Hartree-Fock) analytic wave functions for Al, Si, P, S, Cl, Cl^-, and Ar; the electronic states of H_2O; the ground state of CH_4; the electronic states of benzene; and band structures and self-consistent Coulomb potentials for Si. Methods are shown for evaluating multi-center integrals, which may be used to analyze molecular structure. Optical absorption in $K_3[Cr(CN)_5NO] \cdot H_2O$ is studied. Devices are described whereby the output of a digital computer may be used to print verbal texts and symbolic material. The influence of the Fermi contact term on the effective magnetic field at nuclei in magnetic materials is studied. The nuclei studied include ferromagnetic and non-magnetic types, and the materials studied include magnetic metals, alloys, and salts. (T.F.H.)

31340 (NP-10694) ANNUAL REPORT [ON PHYSICS]. (McGill Univ., Montreal. Eaton Electronics Research Lab.). Aug. 1961. Contract Nonr-3013(00). Includes Thesis: CYCLOTRON RESONANCE IN InSb AND InAs. J. Sosniak. 174p.

High-field susceptibility measurements were made for: $CoSO_4 \cdot 7H_2O$, Ni_2Cl_2, $MnBr_2$, $MnSO_4 \cdot H_2O$, $MnSO_4$, $MnCO_3$, and MnO_2 at field strengths to 5×10^5 oersted. Experiments are described for studies of cyclotron resonance in single crystals of InSb and InAs, to measure the effective masses of the electrons and to determine the structure of the conduction bands of the crystals. The angular dependence of the magnetoresistance effect in n-type InSb, containing 7×10^{14} donors, was measured at room temperature and 77°K. The existence was confirmed of a positive longitudinal magnetoresistance at both temperatures. A discussion is given of a high-field magnet system made from a copper alloy for quasi-continuous operation at low temperatures to eliminate the expense associated with large generating stations and heat exchanger equipment. (B.O.G.)

31341 (NP-10732) PARAMAGNETIC RESONANCE IN THE SOLID STATE. Twelfth Quarterly Report, April 1–June 30, 1961. Hartmut Kallmann (New York Univ., New York). July 1961. Contract DA-36-039-SC-78056. 12p.

Two contributions to the Fifth International Free Radical Symposium at Uppsala, Sweden were made on July 7, 1961. The topics discussed are paramagnetic resonance of trapped electrons in zinc sulfide phosphors and high energy induced free radical formation in benzene-carbon tetrachloride mixtures. These papers are resumés of the research done on Contract No. DA 36-039 SC-78056. (auth)

31342 (NP-10770) PROGRESS REPORT NO. 2 [ON SEMICONDUCTOR USES FOR URANIUM]. (British Columbia. Univ., Vancouver). May 1961. 60p. (CURF R-6)

Experimental work on semiconductor uses of uranium is discussed. A punch-card index system was established for uranium, its compounds, and its uses. The preparation of borides, nitrides, and sulfides of uranium was investigated. Fabrication by cold pressing followed by sintering, hot or reaction pressing, direct growth of massive crystals, flame fusion using a plasma torch, and explosive compact was studied. Work on the determination of electrical conductivity and gathering of x-ray diffraction data on MgO-doped UO_2 samples is described. Possible methods for measuring thermal conductivity were investigated. Studies showed that uranium is an efficient catalyst for ammonia synthesis. Preliminary examinations on the effect of UO_2

additions on the sinterability of MgO_2 gave no unusual results. (M.C.G.)

31343 (NP-10786) DIELECTRIC SCREENING AND SELF-CONSISTENT CRYSTAL FIELDS. Technical Report No. 5. Morrel H. Cohen and James C. Phillips (Chicago. Univ. and Chicago. Univ. Inst. for the Study of Metals). June 1961. Contract Nonr-2121(22). 28p.

The construction of self-consistent Hartree crystal potentials is discussed in terms of screening of "external" ionic potentials by a nearly-free valence-electron gas. An essential preliminary is the introduction of a repulsive potential which replaces the requirement of orthogonality of one-electron valence and core wave functions. Because of the excellent cancellation of core and repulsive potentials, the resulting effective ionic potential V_{eff} is weak. Using an approximate dielectric constant to screen V_{eff}, a prescription for estimating a priori self-consistent Hartree potentials in metals and semiconductors was obtained. The dielectric screening can be extended to include exchange and correlation. Comparison with detailed band calculations for diamond, silicon, and cubic boron nitride revealed the accuracy and limitations of the method. The screening of the longest wave length Fourier component of V_{eff} was predicted quite satisfactorily. By studying bonding and charge transfer effects it was found that non-linear local field corrections (crystal hybridization) are important in screening of shorter wave length Fourier components of V_{eff}. (auth)

31344 (NP-10787) MAGNETO-ACOUSTIC EFFECTS IN TILTED MAGNETIC FIELDS. Technical Report No. 6. Harold N. Spector (Chicago. Univ. and Chicago. Univ. Inst. for the Study of Metals). June 1961. Contract Nonr-2121(22). 38p.

It is shown that the entire Fermi surface can be mapped by using geometic resonances in the sound attenuation in tilted magnetic fields and the drift velocity of the carriers along the magnetic field simultaneously determined. The general features of the phenomena considered do not prove dependent on the particular models used in the calculations. In addition to the results specifically pertaining to tilted fields, it was found that when the assumptions of equal effective masses and relaxation times are dropped for a two band model of a semi-metal, the contribution of the two types of carriers to the ultrasonic absorption is additive. On examining the contribution to the absorption for a model of majority and minority carriers, it was found, also, that the minority carriers dominate the attenuation when they are in the region of geometric resonances. (auth)

31345 (NP-10792) SIMULATION OF AN ATMOSPHERIC TRANSPORT PROBLEM. J. Prawitz (Sweden. Försvarets Forskningsanstalt, Stockholm). July 1961. 21p.

The vertical transport of fall-out particles from nuclear weapon explosions consists of gravitational settling combined with eddy diffusion. This movement was simulated on an analog computer. The particle concentration at different altitudes above the ground, the fall-out rate, and the deposition on the ground were computed. Mathematical formulas used and computer diagrams are presented in detail. (auth)

31346 (NP-10824) RADIATION DAMPING OF SPINNING PARTICLES. H. C. Corben (Space Technology Labs., Inc. Research Lab., Los Angeles). Aug. 9, 1961. 17p.

The dissagreement in the literature on the basic classical equations of a spinning particle is summarized and the relations between the various theories are outlined. The theory of a charged particle with spin is developed for the case in which radiation damping is included and the particle may possess a moment of inertia about an axis orthogonal to the spin. It is found that the radiation damping terms may be formally eliminated from the equations of motion by redefining the momentum, mass and rate of change of spin. The redefined mass is no longer a constant of the motion and the supplementary condition, that the polar vector associated with the spin should vanish in the rest system, does not hold for the redefined spin. (auth)

31347 (ORNL-3180) CERENKOV RADIATION INTENSITY CALCULATIONS FOR Sr^{90} AND Co^{60} IN WATER. R. G. Wymer and R. E. Biggers (Oak Ridge National Lab., Tenn.). Sept. 19, 1961. Contract W-7405-eng-26. 20p.

A method for calculating Cherenkov radiation intensity from an initial electron energy distribution is presented. The Cherenkov radiation intensity from 1 curie of Sr^{90} in secular equilibrium with Y^{90} in water was calculated from the beta energy spectrum to illustrate the use of the method for a pure beta emitter. The Cherenkov radiation intensity from 1 curie of Co^{60} in water was calculated from the Compton electron energy spectrum to illustrate the use of the method for a gamma emitter. The steps necessary to obtain the Compton electron energy spectrum from a gamma emitter are indicated. (auth)

31348 (ORNL-3195) THE RELEASE OF Kr^{85} FROM UO_2 IN ORR CAPSULES. J. L. Scott (Oak Ridge National Lab., Tenn.). Oct. 6, 1961. Contract W-7405-eng-26. 17p.

In an attempt to determine the validity of the method of predicting the release of fission gases from UO_2 suggested recently by Cottrell et al., a series of calculations were made of the expected release of Kr^{85} from prototype Experimental Gas-Cooled Reactor (EGCR) fuel capsule irradiated in the Oak Ridge Research Reactor (ORR). The computed values were then compared with measured values of the per cent Kr^{85} released. In the calculations, the thermal conductivity of the UO_2 was assumed to be 0.028 w/cm-°C in the temperature range from 700 to 1600°C, and in the absence of a precise knowledge of the helium gap, the cases of a 3-mil helium gas and no gap were treated. Values of the release-rate parameter (D′) were estimated from BET surface areas of the UO_2 pellets. Results showed that the measured values of the per cent Kr^{85} released generally fell within or close to the limits set by the 3-mil helium gap and no gap conditions. There was also a definite correlation between the measured values and the 3-mil gap condition when the clad temperature was about 700°C. When the clad temperature was about 800°C, the measured values corresponded better to the no gap condition. The correspondence between measured values and the calculated range lends evidence to the method of Cottrell et al. as well as the value of the thermal conductivity of UO_2 used in the calculations. In addition, the surface area of pressed and sintered UO_2 appears to be indicative of the D′ value for irradiated material at least up to 2400 Mwd/MT of UO_2. (auth)

31349 (SC-4611(RR)) DETERMINATION OF SHOCK WAVE AND PARTICLE VELOCITIES FROM SLANTED RESISTOR DATA. L. M. Barker (Sandia Corp., Albuquerque, N. Mex.). May 1961. 21p.

A method called the slanted resistor technique is being developed to determine the motion produced at a material surface by the interaction of plane shock waves. The mathematical procedure necessary to reduce the slanted resistor data into free surface motion was derived. (auth)

31350 (SCTM-145-61(14)) A QUALITATIVE STUDY ON AN EXPLODING WIRE FUSE. W. D. LaCoss (Sandia

Corp., Albuquerque, N. Mex.). Aug. 1961. Contract [AT(29-1)-789]. 57p.

A study of an exploding wire fuse was undertaken in an effort to develop basic concepts of normal operating fuse criteria that will apply to capacitor energy storage systems. Topics covered include exploding wire characteristics, fusing action and capacitor bank compatibility, methods of heat dissipation for a fuse during normal operation, and methods to determine repetition rate boundaries. (M.C.G.)

31351 (TID-4005(Pts. 3 & 4 Rev.)) SUMMARIES OF PHYSICAL RESEARCH IN PHYSICS AND MATHEMATICS. J. D. Saltzman, ed. (Division of Research, AEC). July 1961. 115p.

A summary is presented of the objectives and current status of individual research projects supported by AEC in the fields of high- and low-energy physics, and mathematics and computer research. (J.R.D.)

31352 (WAPD-TM-258) STRESSES AND DEFLECTION IN THICK, CURVED PLATES. D. S. Griffin and C. M. Friedrich (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Aug. 1961. Contract AT(11-1)-Gen-14. 40p.

A solution is obtained, using the linear theory of elasticity, for the stresses in a long curved plate due to pressures on the curved surfaces and forces or deflections specified on the straight edges. The stress computations are programmed in FORTRAN II for convenience in obtaining numerical results. Since the theory contains none of the simplifying assumptions used in the elementary thin beam theory, or even those used in the more "refined" curved beam theories, it is applicable to curved plates of any thickness. A comparison is made between this theory and the elementary theory showing the range of applicability of the simpler theory. Even though an electronic computer may not be available, the theory is computationally no more difficult than the "refined" thin beam theories. An immediate and typical application of this solution is found in the design of thick, pressure seals of the "canopy" type. (auth)

31353 (AEC-tr-4814) ON THE KINETICS OF THE BREAKDOWN OF SUPERFLUIDITY IN HELIUM. V. P. Peshkov and V. K. Tkachenko (Akademiya Nauk S.S.S.R. Institut Voprosov Fiziki im. S. I. Vavilova). Translated by Helen J. Chick and William E. Keller (Los Alamos Scientific Lab., N. Mex.). [1961]. 18p.

Experiments were conducted on the kinetics of superfluidity breakdown with heat transfer in a He-filled capillary. It was found that even at large (1.5 times) supercritical velocities, the formation of turbulent sources inside the capillary is very difficult, but once they are established, turbulent fronts are propagated on both sides. The turbulent front propagation can be described as the origin of vortex rings. (D.L.C.)

31354 (JPRS-8832) DUOPLASMATRON ION SOURCE WITH AUXILIARY MAGNETIC FIELD. (Translation). (VEB Vakutronik Dresden). Feb. 1961. 6p.

A high-current-density duoplasmatron ion source is described which is mainly used for ionization of H_2, D_2, and electropositive gases. Its advantage is high ionization efficiency at relatively low discharge current. In continuous operation, the maximum ion current density possible is 65 amp/cm^2, while in pulsed operation it reaches 325 amp/cm^2. It can be used as an electron beam source with a current density on the order of 500 amp/cm^2. (D.L.C.)

31355 (TG-230-T248) GENERALIZATION OF EXPERIMENTAL DATA ON THERMAL DIFFUSION OF GASES. A. G. Usmanov and A. N. Berezhnoi. Translated by B. W. Kuvshinoff (Johns Hopkins Univ., Silver Spring, Md.) from Izvest. Vysshykh Ucheb. Zavedenii, Khim. i Khim. Tekhnol., No. 1, 8-13(Jan.-Feb. 1960). 7p.

A method of applying generalized experimental data on molecular transfer in gases to the process of thermal diffusion for the purpose of determining separation and related quantities, the thermal diffusion constant and the thermal diffusion ratio, is described. An equation was developed for the relative separation of a binary gas mixture during thermal diffusion. (M.C.G.)

31356 (UCRL-Trans-701(L)) TRANSFERENCE NUMBERS FOR KCl CRYSTALS. F. Kerhoff. Translated by S. Shewchuck (Univ. of California Lawrence Radiation Lab., Livermore) from Z. Physik, 130: 449-56(1951). 11p.

The dependence of the magnitude of electrical conductivity and the transference numbers of KCl on the presence of bivalent cations was studied. The dependence of the electrical conductivity on temperature for analytically pure KCl was determined. After repeated recrystallization to decrease impurities it was possible to measure the transference number in a temperature range in which only electronic conductance takes place. At 600°C the transference number of the cations was 0.7 and that of the anions 0.3. In crystals with impurities of Ca^{2+}, the transference number was practically equal to 1 in the entire temperature range. These results supported earlier conclusions that every built-in Ca^{2+} ion in the cation lattice element produces a lattice void which offers to an adjacent cation the possibility of migration. (M.C.G.)

31357 (UCRL-Trans-716(L)) ON THE MODIFICATION OF THE STATISTICAL MODEL OF THE ATOM WITH THE CORRELATION CORRECTION. P. Gombas. Translated by Stephen G. Brush (Univ. of California Lawrence Radiation Lab., Livermore) from Ann. Physik (7) 7: 1-7(1961). 8p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 17403.

31358 (UCRL-Trans-720(L)) SOLUTION OF THE BASIC EQUATION FOR THE STATISTICAL ATOM MODIFIED BY CORRELATIONS, FOR NON-ZERO PRESSURE. P. Gombas. Translated by Stephen G. Brush (Univ. of California Lawrence Radiation Lab., Livermore) from Acta Phys. Acad. Sci. Hung., 5: 123-9(1955). 6p.

Solutions are determined for the basic statistical equation modified with the correlation correction for the rare gas atoms Ne, Ar, Kr, and Xe, for the positive alkali ions Na^+, K^+, Rb^+, and Cs^+, and for the negative halogen ions F^-, Cl^-, Br^-, and I^-, for nonzero pressures. (auth)

31359 DEFINITION OF THE PERFECT GAS. P. T. Landsberg (University Coll., Cardiff, Wales). Am. J. Phys., 29: 695-8(Oct. 1960).

Usual definitions of the perfect gas are analyzed, and changes are proposed. The considerations lead to a view which, in its most extreme form, might run as follows: The ideal gas concept as used at present is unduly influenced by classical ideas, and out-of-date; but it can readily be modernized. The proposal is to define the ideal gas by the equation of state $pv = gU$, where g is a constant. The ideal classical gas is defined by the additional relation $pv = NkT$. These two equations lead to a system whose heat capacities C_v, C_p are independent of temperature, as normally required in elementary discussions. In other words, it is proposed that the ideal gas shall remain a generalization of the system for which $pv = NkT$ and C_v and C_p are temperature independent, but it shall be defined by $pv = gU$ rather than by $pv = NkT$. (auth)

31360 THEORY OF ISOTOPE SHIFTS IN HEAVY ATOMS. N. J. Ionesco-Pallas (Inst. for Atomic Physics, Bucharest). Ann. Physik (7), 8: 9-27(1961). (In English)

A general theory is given for the isotope shift of energy levels in heavy atoms. The methods used are based neither on the simple perturbation theory nor on the solution of the Darwin-Gordon differential equations for the region inside the nucleus. It is sufficient to solve an integral equation from which result both the distortion effect of the wave function, due to the spatial extension of the nucleus, and the specific nuclear effects of surface and deformation. The screening effects of the electrons in the closed shells, the effect of nuclear compressibility, and other effects are also analyzed. The article probably exhausts the main causes which account for the global effect of isotope shift. The values obtained theoretically for the isotopic constants of the nuclei fairly well agree with the experimental ones. (auth)

31361 INTERMOLECULAR ENERGY TRANSFER AND CONCENTRATION DEPOLARIZATION OF FLUORESCENCE. A. Kawski (Technical Univ., Danzig). Ann. Physik (7), 8: 116-19(1961). (In German).

The experimental results obtained by the author and by Pheofilov and Sveshnikov on the concentration depolarization for anthracene and fluorescein were compared critically with the Forster theory expanded by Ore on the self-depolarization for the previously determined (Bojarski and Kawski, Ann. Physik 5, 31(1959)) critical concentration. In both cases a good agreement of the experiment with theory was obtained. (tr-auth)

31362 IONIZATION EQUILIBRIUM EQUATION OF STATE. Carl A. Rouse (Univ. of California, Livermore). Astrophys. J., 134: 435-46(Sept. 1961). (UCRL-5695-T(Pt. II Rev.))

A complete solution to Saha's equation is obtained for a monatomic gas. The method of solution involves iteration with respect to the electron pressure or electron concentration and can be applied to the simultaneous calculations of any number of ions. Some results are given in tabular form. (auth)

31363 HYDROMAGNETIC TURBULENCE. S. Nagarajan (Tata Inst. of Fundamental Research, Bombay). Astrophys. J., 134: 447-55(Sept. 1961).

A rederivation of Chandrasekhar's elementary theory of hydromagnetic turbulence is given, which makes clear the physical implications of his extension of Heisenberg's ideas to hydromagnetics. The cascade equations are reduced to two equivalent differential equations for the case of finite viscosity and resistivity. A perturbation procedure is employed to prove that one of Chandrasekhar's solutions (the velocity mode) becomes unacceptable for the case of finite viscosity and resistivity. The implications of this result are discussed critically and compared with other theories. (auth)

31364 THE VIRIAL TENSOR AND ITS APPLICATION TO SELF-GRAVITATING FLUIDS. Norman R. Lebovitz (Yerkes Observatory, Williams Bay, Wis.). Astrophys. J., 134: 500-36(Sept. 1961).

The well-known conditions for the Maclaurin spheroids and and the Jacobi ellipsoids are found as consequences of the tensor virial equations. The perturbation forms of the tensor virial equations are derived and applied to the stability of the self-gravitating sphere, the Maclaurin spheroids, and the Jacobi ellipsoids. The effect of rotation on the oscillation frequencies of a self-gravitating sphere is found in detail for second-order harmonic deformations of the equilibrium shape. To first order in the angular speed Ω, the five oscillation frequencies associated with the five second-order harmonics are $\sigma_0 - \Omega$, $\sigma_0 - \frac{1}{2}\Omega$, σ_0, $\sigma_0 + \frac{1}{2}\Omega$, and $\sigma_0 + \Omega$, where σ_0 is the Kelvin frequency of the non-rotating, spherical liquid mass. Two critical values of the eccentricity are found for the Maclaurin spheroids. The first, $e = 0.8127$, marks the point where the series of Maclaurin spheroids has a member in common with the Jacobi ellipsoids. The second, $e = 0.9529$, is the place where the Maclaurin spheroids become unstable. The effect of certain special perturbations of the Maclaurin spheroids with these values of the eccentricity is discussed. (auth)

31365 THE DEPENDENCE OF ION AND ELECTRON MOBILITY UPON MOLECULAR STRUCTURE IN DIELECTRIC LIQUIDS. I. Adamczewski (Technical Univ., Danzig). Atompraxis, 7: 327-32(Sept. 1961). (In German)

The viscosity coefficient of dielectric liquids was found to be dependent upon molecular structure and temperature. From this a general formula for ion and electron mobility was derived. This formula includes the dependence of mobility upon molecular structure and temperature, thus making it possible to give a theoretical explanation of other published experimental results. In addition, the formula can be used to calculate ion mobility for a number of other liquids at various temperatures. (auth)

31366 THE INFLUENCE OF THERMOELECTRIC EFFECTS ON THE MAXIMUM TEMPERATURE IN A RADIALLY CONSTRICTED GAS DISCHARGE BETWEEN ELECTRODES. P. W. Seymour (Australian National Univ., Canberra). Australian J. Phys., 14: 279-94(June 1961).

A method for estimating the maximum temperature in a steady-state, centrally constricted, highly ionized deuterium discharge between electrodes was previously described. The analysis applied to discharges not too long, so that bremsstrahlung loss could be neglected compared to the main heat loss by conduction to the electrodes, and thermoelectric effects were not included. The analysis is generalized to include thermoelectric effects, and carried through for strictly longitudinal flow, for which at every point within the discharge the heat flux vector q and the current density vector j are parallel to the magnetic field H. A simple continuity argument shows that $q + Vj = 0$, where V is the electric potential, but now the equipotential surface on which $q = V = 0$ is displaced from midway between the electrodes nearly to the cathode. In the linear case the maximum temperature is displaced somewhat from the midway position towards the anode. A similar remark applies to the constricted discharge. The important influence of inclusion of thermoelectric effects is that the maximum temperature is increased by approximately 14% for about the same applied voltage producing a given current in a particular discharge geometry. The characteristic relating the maximum temperature and resistance ratio ϵ and the radial compression ratio ν obtained in the earlier paper is not changed by thermoelectric effects. Comparison of voltage and also temperature versus distance characteristics for linear and constricted discharges without and with thermoelectric effects is given by means of graphs. (auth)

31367 CHARGED PARTICLE TRAJECTORIES IN STATIC ELECTRIC AND MAGNETIC FIELDS. K. J. Ausburn (Newcastle Univ. Coll., Tighe's Hill, New South Wales, Australia). Australian J. Phys., 14: 310-13 (June 1961).

Relativistic expressions for the trajectory curvature and torsion in terms of the electric and magnetic field dis-

tributions are derived. The expressions may be useful in the analytical solution of simple trajectory problems and may be extrapolated from their origin by means of the canonical equations. (L.N.N.)

31368 THERMIONIC GENERATION OF ELECTRICITY. M. A. Cayless (Associated Electrical Industries (Rugby) Ltd., Rugby, Warwickshire, Eng.). Brit. J. Appl. Phys., 12: 433-42(Sept. 1961).

A thermionic generator of electricity is essentially a diode valve in which electrons emitted from a hot cathode flow to a cooler anode, producing an electric current. Such devices have considerable possibilities as useful generators in a number of fields. The present position and future trends are reviewed. Although engineering design and applications are considered, emphasis is on physical processes associated with these devices and the progress made toward understanding them. (auth)

31369 CATHODE SPUTTERING IN INERT-GAS GLOW DISCHARGES. B. J. Stocker (Mullard Research Labs., Salfords, Redhill, Surrey, Eng.). Brit. J. Appl. Phys., 12: 465-8(Sept. 1961).

Measurements were made of the rate of deposition of sputtered molybdenum films in abnormal glow discharge in inert gases at 3 to 21 mm Hg as a function of the gas pressure p and the current i through the discharge tube. The rate of sputtering was found to be proportional to $(i/p)^{2.5}$ in both neon and the Penning mixture 99% neon–1% argon. In helium, sputtering was negligible, but the addition of only a trace of neon caused appreciable sputtering to occur. (auth)

31370 PHOTOCONDUCTION IN CADMIUM SULFIDE. J. F. Duncan and D. N. Sitharama Rao (Univ. of Melbourne). Brit. J. Appl. Phys., 12: 511-13(Sept. 1961).

Discrete voltage pulses, of amplitude depending on the energy of the incident radiation, were observed in the photoconduction of cadmium sulfide at room temperature. At 4800 to 8000 Å, the pulse height varies in a manner similar to the photocurrent with wavelength. Below 3500 Å it is closely proportional to the energy of the radiation. Cadmium sulfide can be used as a spectrophotometric device in this region when only small numbers of quanta are available. (auth)

31371 SPECTRAL RESPONSE OF ANTIMONY–CAESIUM PHOTOCATHODES. J. B. Birks and I. H. Munro (The University, Manchester, Eng.). Brit. J. Appl. Phys., 12: 519-22(Sept. 1961).

Measurements were made of relative photoelectric quantum efficiency $\eta(\lambda)$ of $SbCs_3$ cathodes of photomultipliers with Pyrex and quartz windows, at λ = 200 to 650 mμ. $\eta(\lambda)$ depends on the window transmittance $W(\lambda)$, the cathode absorbance $A(\lambda, d)$, the absolute photoelectric quantum efficiency $Q_0(\lambda)$ and the photoelectron escape probability $f(\lambda, d)$. Comparison with other data allows the separation of these factors, yielding inter alia the absorption spectrum of $SbCs_3$ down to λ = 220 mμ, and the absolute photoelectric threshold curve $Q_0(\lambda)$ plotted against λ. The optimum thickness for a thin cathode is d = 200 Å. Errors in other published data are noted, and methods of increasing $\eta(\lambda)$ and of improving scintillation detectors are discussed. (auth)

31372 AVERAGE KINETIC ENERGY OF DIFFUSING PARTICLES IN DISCHARGE AND ELECTRON TUBES. M. A. Cayless (Associated Electrical Industries (Rugby) Ltd., Rugby, Warwickshire, Eng.). Brit. J. Appl. Phys., 12: 523-4(Sept. 1961).

It is shown that the mean kinetic energy per particle ϵ for particles with a positive velocity component V_Z is 2kT, evaluating over one hemisphere only. For particles flowing across a surface within the body of the gas, the integrals must be evaluated over all directions in both hemispheres, and a result of $\epsilon = \frac{5}{2}kT$ is obtained. In the latter case, perturbation in the distribution corresponding to the flow is considered, and the relation is valid under all ordinary conditions of flow. (L.N.N.)

31373 MAGNETIC PROPERTIES OF URANIUM TELLURIDES. III. PREPARATION, CRYSTAL STRUCTURE AND MAGNETIC BEHAVIOUR OF URANIUMOXYTELLURIDE. W. Trzebiatowski, J. Niemiec, and A. Sepichowska (Inst. of Physical Chemistry, Polish Academy of Sciences, Wrocław). Bull. acad. polon. sci. Ser. sci. chim., 9: 373-7(1961). (In English)

The uranium oxytelluride UOTe was prepared and the crystal structure and magnetic properties determined. The compound was prepared according to the following reactions: $UO_2 + UTe_2 \rightarrow 2\ UOTe$ or $UO_2 + U + 2\ Te \rightarrow 2\ UOTe$. Powder diagrams were obtained with CuK radiation. Calculated and observed intensities of powder diffraction were compared. The magnetic susceptibilities were determined between 85 and 350°K. (M.C.G.)

31374 IRREVERSIBLE PROCESSES IN GASES WITH INTERNAL DEGREES OF FREEDOM IN WEAKLY COUPLING APPROXIMATION. B. Baranowski (Université Libre, Brussels). Bull. classe sci., Acad. roy. Belg., (5) 47: 111-22(1961). (In English)

The theory of weakly coupled systems, introduced Prigogine and his coworkers, is extended to polyatomic gases. (auth)

31375 SUPERCONDUCTING MAGNETS. R. H. Kropschot and V. Arp (National Bureau of Standards, Boulder, Colo.). Cryogenics, 2: 1-15(Sept. 1961). (In English)

The problem of attaining high fields with superconducting magnets is treated. Some of their advantages and possible uses are illustrated. Fundamentals of superconductivity are outlined. The basic types of superconducting magnets, the air core solenoids and ferromagnetic cores, are described. Nb, Mo–Re alloy, and niobium stannide wires were among the materials which showed the most promise as superconducting magnets. The possibility that thin films might be used for superconducting magnet windings for fields of the order of 100 kgauss is discussed. Special design considerations including forces on magnets, time constants, field distribution, and operational precautions were considered. (M.C.G.)

31376 MEASUREMENTS OF THE PRESSURE DEPENDENCE OF LIQUID NORMAL HYDROGEN. A. Van Itterbeck and O. Verbeke (Institut voor Lage Temperaturen en Technische Fysica, Louvain, Belg.). Cryogenics, 2: 21-5(Sept. 1961). (In English)

Measurements of the dependence of the density ρ of liquid normal hydrogen on pressure were carried out below 20°K and up to near the melting curve (150 kg cm^{-2}). These measurements were compared with the existing ones on liquid normal hydrogen by Bartholomé and Johnston. The former were carried out below 20°K and the latter above 20°K. Very good agreement was found at the normal boiling point. However at the lower temperatures, a large difference appeared with the data of Bartholomé. Comparing the velocity of sound calculated from these results or from those of Bartholomé with the experimental values determined directly in the laboratory, a good agreement was found except for Bartholomé's values at the lower temperatures. It was concluded that Eucken's equation for the

density as a function of pressure has to be reconsidered. (auth)

31377 ISOTHERMAL FLOW OF LIQUID HELIUM-II IN WIDE CAPILLARIES. S. M. Bhagat and K. Mendelssohn (Clarendon Lab., Oxford). Cryogenics, 2: 34-8 (Sept. 1961). (In English)

The isothermal flow of liquid helium-II under gravity was investigated in capillaries varying from 8×10^{-3} to 7×10^{-2} cm in diameter between 1.3 and 2.1°K. Except for the narrowest long tube, the flow velocity was found to depend in all cases on the initial pressure difference. This effect was explained in terms of an eddy viscosity due to turbulence in the superfluid component. (auth)

31378 THERMOMECHANICAL PRESSURE MEASUREMENTS IN LIQUID HELIUM-II. S. M. Bhagat and P. R. Critchlow (Clarendon Lab., Oxford). Cryogenics, 2: 39-42(Sept. 1961). (In English)

Measurements of the thermomechanical pressure were carried out on capillaries of 0.01 to 0.08 cm diameter between 1.3 and 1.8°K. In all cases the behavior showed a marked change at a critical heat current. Below this value the only process of dissipation was the viscosity of the normal fluid. While above the critical heat current mutual friction can explain the observed temperature differences it is insufficient to account for the pressure differences. An attempt was made to explain this discrepancy by the existence of an eddy viscosity in the superfluid. (auth)

31379 ELECTRICAL CONDUCTION AND BREAKDOWN IN HIGH-PRESSURE (0.25-300 mm) RARE GASES. R. Forman (Union Carbide Corp., Parma, Ohio). J. Appl. Phys., 32: 1651-8(Sept. 1961).

The current-voltage characteristics of high-pressure (0.25-300 mm) rare-gas diodes have been measured. Data were taken on diodes containing xenon, argon, and helium as the ambient gas and tungsten, tantalum, rhenium, thoriated tungsten, and an oxide cathode as filamentary cathodes. Some unexpected phenomena were observed and some of these general results can be summarized as: The current vs voltage characteristics of argon- and xenon-filled diodes, at gas pressure above 1 mm, do not obey any space-charge law if the cathode temperature is above 2400°K; the above violation of space-charge relations in argon and xenon-filled diodes is found with tungsten, tantalum, or rhenium filaments, which can be operated above 2400°K. When thoriated tungsten or the oxide cathode, which operate below 2400°K, are used as filaments, the current-voltage characteristics of the diode follow a space-charge relation (current-voltage characteristics independent of temperature); the current vs voltage characteristics of helium-filled diodes, however, do obey the space-charge relations at all filament temperatures available with the present cathode materials; some very unusual early breakdown phenomena (breakdown at potentials below ionization potential) were observed in these high-pressure rare-gas diodes employing a hot cathode. These data can be explained qualitatively by postulating the existence of thermally generated xenon or argon gas ions at temperatures in the range of 2400°K. An attempt will be made to justify this assumption by a semiquantitative theoretical treatment based on Saha's thermal ionization theory rather than the surface ionization theory of Langmuir and Kingdon. (auth)

31380 GENERALIZED COUPLED MODE THEORY. M. C. Pease (Stanford Research Inst., Menlo Park, Calif.). J. Appl. Phys., 32: 1736-43(Sept. 1961).

The pairwise coupling of modes in distributed systems such as the traveling-wave parametric electron-beam amplifier and many other types is shown to permit only two types of interaction. One type, called β coupling, results in the periodic interchange of the signal between the modes, as typified in the Kompfner-null coupler. The other, γ coupling, results in the exponential growth of the mode, as in the TWT and in the pump section of a parametric amplifier. The nature of the resultant interaction is a direct consequence of the underlying relations contained in the conservation law that applied throughout the system, i.e., in the separate parts of the system and that is independent of the various coupling coefficients. The "rank" and "signature" of the metric that expresses this conservation law is sufficient to determine the type of behavior. The direction of flow of energy in the coupled modes imposes a duality on these relations. Where modes of opposite directionality are coupled, β coupling causes system amplification, while γ coupling causes system interchange. These relations are generalizations of effects that were studied in detail for many specific systems. They are not, however, consequences of the details of the system but are, rather, the only alternatives possible under assumptions that are broad in scope and generally applicable to devices of interest. (auth)

31381 QUASI-BRILLOUIN ELECTRON STREAMS. M. H. Miller (Univ. of Michigan. Ann Arbor). J. Appl. Phys., 32: 1791-3(Sept. 1961).

An electron stream model, discarding the assumption of laminar flow, is derived. The hydrodynamic description of a d-c particle flow is given in terms of the conservation equations $\vec{\nabla} \cdot \rho\vec{v} = 0$, $-\eta[\vec{E} + \vec{v} \times B] = (\vec{v} \cdot \vec{\nabla})\vec{v} + \rho^{-1}(\vec{\nabla} \cdot \rho\vec{P})$, and $2n\Phi = \vec{v} \cdot \vec{v} + < \vec{u} \cdot \vec{u} >$. Additional information about the velocity distribution function is provided indirectly by specifying by analogy to laminar Brillouin flow, average properties of the flow. Graphical comparison between this quasi-Brillouin and the laminar Brillouin flow, is presented. (L.N.N.)

31382 THERMIONIC EMISSION FROM A TANTALUM CRYSTAL IN CESIUM OR RUBIDIUM VAPOR. H. F. Webster (General Electric Research Lab., Schenectady, N. Y.) J. Appl. Phys., 32: 1802-3(Sept. 1961).

Thermionic emission was measured from a hemispherical tantalum crystal with its work function altered by alkali metal sorption. Data are graphically presented. Emission density is strongly dependent upon the crystallographic face of tantalum, and emission pattern changes are different for cesium and rubidium. (L.N.N.)

31383 MOMENTUM-CORRELATION FUNCTION IN A RAYLEIGH GAS. Robert M. Mazo (California Inst. of Tech., Pasadena). J. Chem. Phys., 35: 831-5(Sept. 1961).

The time-correlation function in an equilibrium ensemble of the momentum of a heavy particle imbedded in a gas of noninteracting light particles is calculated. The technique used is a density expansion of the correlation function. No statistical hypothesis beyond that of canonical ensemble at the initial time is used. (auth)

31384 ELASTIC AND INELASTIC SCATTERING OF LOW-VELOCITY H^+ AND H_2^+ IN HYDROGEN. W. H. Cramer (Univ. of Florida, Gainesville). J. Chem. Phys., 35: 836-8(Sept. 1961).

Cross sections were measured in the energy range 4 to 400 ev for elastic scattering and charge exchange of H^+ and H_2^+ ions in hydrogen. The results are compared with similar measurements for deuterium ions in deuterium. Charge exchange was observed over the entire energy range for H_2^+, but was detected only above 50 ev for H^+. Constants for empirical potential functions were evaluated and are tabulated. (auth)

31385 SCATTERING OF HIGH-VELOCITY NEUTRAL PARTICLES. XII. He–CH_4; He–CF_4. CH_4–CH_4 AND CF_4–CF_4 INTERACTIONS. I. Amdur (Massachusetts Inst. of Tech., Cambridge), M. S. Longmire, and E. A. Mason. J. Chem. Phys., 35: 895-8(Sept. 1961).

Collision cross sections were measured for helium atoms with energies between 500 and 2100 ev, scattered in room temperature CH_4 and CF_4. The results were analyzed to obtain the average potential between a helium atom and a CH_4 molecule, $[V(r)]_{Av} = 602/r^{9.43}$ev, for r between 1.92 and 2.37 A, and the average potential between a helium atom and a CF_4 molecule, $[V(r)]_{Av} = 6.18 \times 10^6/r^{17.51}$ev, for r between 2.43 and 2.74 A. This He–CH_4 potential is consistent with one valid at larger separation distances which was obtained by combining potentials derived from high-temperature viscosity and second virial coefficients of helium, and from high-temperature viscosity coefficients of methane. A procedure which assumes the centers of force to reside in the peripheral H or F atoms was used to analyze these average atom-molecule interactions in terms of the effective He–H and He–F interatomic potentials. These interatomic potentials were combined with the potential previously determined for He–He to obtain effective H–H and F–F potentials for atoms in different CH_4 and CF_4 molecules. These effective interatomic potentials were then summed and averaged over all molecular orientations to yield the average potential between two CH_4 molecules, $[V(r)]_{Av} = 5.64 \times 10^6/r^{15.47}$ev, for r between 2.47 and 3.06 A, and the average potential between two CF_4 molecules, $[V(r)]_{Av} = 1.17 \times 10^{22}/r^{39.27}$ev, for r between 3.43 and 3.77 A. This CH_4–CH_4 potential is consistent with one valid at larger separation distances which was derived from measurements on gaseous viscosity at high temperatures. (auth)

31386 ON THE CLASSICAL BOLTZMANN EQUATION FOR GASES. Frank C. Andrews (Univ. of California, Berkeley). J. Chem. Phys., 35: 922-4(Sept. 1961).

With great simplicity the Boltzmann equation for dilute classical gases is formulated from the reduced Liouville equation by using the three assumptions: no three-body effects, collision time much less than the experimental time, and negligible change in local properties of the system over distances of order of the range of the intermolecular forces. The nature of these assumptions sheds some light on recent attempts to generalize the Boltzmann equation. It was easy formally to relax the first assumption to permit more than two-body effects. The resulting equation is an intuitive extension of the Boltzmann equation. (auth)

31387 DIPOLE MOMENT OF HD. [PART] II. S. M. Blinder (Harvard Univ., Cambridge, Mass.). J. Chem. Phys., 35: 974-81(Sept. 1961).

The permanent electric dipole moment in the ground vibrational state of HD is computed by a variational technique (generalized perturbation method). Implicit account is thereby taken of contributions from higher molecular states of $^1\Sigma_\mu^+$ symmetry. The value $(\mu_z)_{v=0} = 5.67 \times 10^{-4}$ Debye unit is assigned. Factors affecting the accuracy of the computation are discussed in detail. It is shown that an effective dipole moment function may be defined despite the fact that the dipole arises from a vibrational-electronic interaction. (auth)

31388 CHARGE DISTRIBUTION AND ELECTRIC FIELD GRADIENTS IN IONIC CRYSTALS. Geneva G. Belford, Robert A. Bernheim, and H. S. Gutowsky (Univ. of Illinois, Urbana). J. Chem. Phys., 35: 1032-8(Sept. 1961).

A method is presented by means of which one can investigate the validity of the point-charge model often used for the calculation of electric field gradients in ionic crystals. The asymmetry parameter of the electric field gradient at a nucleus and the Eulerian angles describing the orientation of the field gradient's principal axes with respect to the crystallographic axes are linear functions of the point charges assigned to each set of atoms in the lattice. If the unit cell is of low symmetry and if there are more than one set of nuclei for which quadrupole interaction data can be observed, the number of observables and equations may equal or exceed the number of unknown charges, thereby enabling the charge distribution to be determined and its internal consistency checked. Such is the case for spodumene, for which the charge distribution thus calculated is neither internally consistent nor very reasonable. An analysis is made of the sensitivity of the apparent charge distribution to experimental errors in the quadrupole interactions, and the errors are found to be much too small to account for the anomalies. However, further investigations, including a refinement of the crystallographic parameters of spodumene, are necessary before the anomalies could be attributed to deficiencies in the point-charge model. With allowance for the uncertainties in the charge distribution, the analysis lends some support to a value of ≈ 0.04 b for Q_7, the nuclear quadrupole moment of Li^7. Further charge distribution anomalies result from a similar, but less detailed treatment of another silicate, beryl, which gives a very approximate value of $Q_9 \approx 0.1$ b for Be^9. (auth)

31389 VIBRONIC COUPLING. I. MATHEMATICAL TREATMENT FOR TWO ELECTRONIC STATES. Robert L. Fulton and Martin Gouterman (Harvard Univ., Cambridge, Mass.). J. Chem. Phys., 35: 1059-71(Sept. 1961).

A general mathematical treatment of vibronic coupling of two electronic states in molecules and dimers is presented. The 2×2 matrix Hamiltonian, which is derived, is shown to reduce to two one-dimensional Hamiltonians provided a certain minimum amount of symmetry is present. Some general selection rules governing electronic transitions to these states from the ground state are obtained, showing that the spectral distribution in hot bands may differ considerably from that in normal bands when vibronic coupling occurs. A special model which considers the coupling to arise from a single mode of vibration is presented. Two limiting cases which can be treated approximately by perturbation theory are considered in detail. These are shown to give rise to a pseudo Jahn-Teller effect and to vibrational borrowing in the two different limits. (auth)

31390 ISOTOPIC FRACTIONATION OF LITHIUM IN SPUTTERING. J. M. Fluit, L. Friedman, A. J. H. Boerboom, and J. Kistemaker (Laboratorium voor Massaspectrografie, Amsterdam). J. Chem. Phys., 35: 1143-4(Sept. 1961).

Samples of lithium metal were cut in an argon atmosphere. Sputtering experiments were carried out with 5 and 20 kev Ar^{40} ion beams, and a conical quartz cup was mounted to collect the sputtered lithium. The intensities of the ion beams were controlled to permit roughly 0.1 g of lithium to be sputtered. The results at different beam intensities and with different beam energies are tabulated along with isotopic analysis of the target lithium. (P.C.H.)

31391 STIFFNESS OF ELECTRON BEAMS. J. L. Palmer and Charles Süsskind (Univ. of California, Berkeley). J. Electronics and Control (1), 10: 365-73(May 1961).

A new parameter for use with electron-beam devices is defined as a quantitative measure of the extent to which

the beam withstands the effects of transverse forces. The new figure of merit can be used to compare the effectiveness of various methods of constraining the beam, as illustrated by application to the cases of space-charge-balanced flow (including Brillouin flow and immersed flow), periodic focusing, Harris flow, E- and C-type flow, and M-type flow. Stiffness is defined as the rate of change of force (in the direction transverse to that of beam travel) that acts to restore a displaced electron to its equilibrium trajectory in a laminar beam. (auth)

31392 THE SIGNIFICANCE OF THE HALL EFFECT FOR THREE MHD GENERATOR CONFIGURATIONS. L. P. Harris and J. D. Cobine (General Electric Research Lab., Schenectady, N. Y.). J. Eng. Power, 83: 392-6 (Oct. 1961).

Analyses are presented for the influence of the Hall effect on electrical terminal characteristics, generated power per unit volume, pressure gradient, and generator efficiency in three configurations for MHD generators. The results indicate that desirable generator characteristics can be attained when the Hall effect is either negligible or dominant. (auth)

31393 EXPERIMENTS WITH MHD POWER GENERATION. S. Way, S. M DeCorso, R. L. Hundstad, G. A. Kemeny, W. Stewart, and W. E. Young (Westinghouse Research Labs., Pittsburgh). J. Eng. Power, 83: 397-408 (Oct. 1961).

The development of an experimental MHD electrical generator which derives its energy from the combustion of a liquid fuel and oxygen is described. The fuel burned is a number 2 distillate oil in which a soluble potassium octoate is mixed to increase the degree of thermal ionization in the product gas. The actual generating volume is approximately 125 cubic inches. The rating of 10 KW was exceeded. Some of the broad construction features of the generator and problems arising during its operation are described. The fuel and combustion systems, fuel characteristics, and the electrical and magnetic aspects are discussed. The theory of MHD power generation in a uniform duct is presented. Results of the experiments are presented and actual performance compared with theory. Photographs and sketches of the various components and curves of power and voltage are included. (auth)

31394 DRIFT RATE IN A DIPOLE FIELD. John S. Lew (Air Force Special Weapons Center, Kirtland AFB, N. Mex). J. Geophys. Research, 66: 2681-5(Sept. 1961).

Expressions are found for the drift of charged particles in the field of a magnetic dipole. These give, in the guiding center approximation, the longitude drift rate and drift period of relativistic particles with mirror points at any latitude. The results are applied to trapped electrons and protons in the earth's magnetic field, and are adapted for further use in such applications. (auth)

31395 THE KNIGHT SHIFT IN THE SUPERCONDUCTING STATE. R. Suzuki and M. Akano (Tokyo Coll. of Science). Nuovo cimento (10), 21: 559-62(Aug. 1, 1961). (In English)

A method is presented for calculating the superconducting Knight shift as a function of the superconducting energy gap, for temperatures near 0°K. This method has the advantage that the calculated Knight shift does not vanish upon extrapolation to maximum energy gap values. (T.F.H.)

31396 HEAT CONDUCTION BY LIQUID HELIUM II IN CAPILLARY TUBES. I. TRANSITION TO SUPERCRITICAL CONDUCTION. D. F. Brewer and D. O. Edwards (Clarendon Lab., Oxford). Phil. Mag. (8), 6: 775-90(June 1961).

Measurements were made of the heat conduction by liquid helium II in capillary tubes of diameter 52.0, 107.6, and 366 microns. The results on subcritical flow were described previously, and observations in the transition region to supercritical conduction are discussed. Outstanding features of the transition are spontaneous fluctuations in the thermal resistance; very large hysteresis effects in the resistance at low temperatures in the wide tubes, which decrease as the lambda point is approached, and which depend on the previous history of the helium; and sensitivity of the thermal resistance to mechanical shock or vibration, including permanent changes from one branch of the hysteresis loop to the other. The observations, which include measurements of the critical velocity as a function of tube size and temperature, are discussed in terms of the vortex line theory of Feynman and its development by Vinen, which are found to give good agreement with the experiments. (auth)

31397 INDUCED AND SPONTANEOUS EMISSION IN A COHERENT FIELD. [PART] IV. I. R. Senitzky (Army Signal Research and Development Lab., Fort Monmouth, N. J.). Phys. Rev., 123: 1525-37(Sept. 1, 1961).

Interactions between molecules and an electromagnetic field in a resonant cavity are discussed. The perturbation restriction is removed, but the molecules are still assumed to undergo a small change during the time under consideration. The resonant and nonresonant cases of molecular distributions are considered. The generalization of the conventional concepts of induced and spontaneous emission, the applicability to a molecular amplifier during the buildup period, and the re-examination of a previous calculation concerning the fundamental limits of molecular amplification are discussed. (L.N.N.)

31398 SPACE-CHARGE LIMITED CURRENT RELATION IN HIGH-PRESSURE GAS DIODES. R. Forman (Union Carbide Corp., Parma, Ohio). Phys. Rev., 123: 1537-41(Sept. 1, 1961).

A theory for space-charge conditions in high-pressure diodes is developed which shows that the current obeys a $V^{1/4}$ power relation rather than the usual assumed V^2 relation. In addition, the theory predicts that the current in high-pressure diodes, at a constant anode voltage, varies as $p^{-1/4}$. Experimental data, taken in diodes filled with the inert gases, argon, neon, and helium, are presented to illustrate the validity of the theory. (auth)

31399 ELECTRON TRANSPORT AT HIGH TEMPERATURES IN THE PRESENCE OF IMPURITIES. H. L. Frisch (Bell Telephone Labs., Murray Hill, N. J.) and J. L. Lebowitz. Phys. Rev., 123: 1542-9(Sept. 1, 1961).

Linear transport properties of electrons in a solid are investigated when both phonon and impurity scattering are important. The problem is treated for the case where Maxwellian statistics apply and the electrons are described by a classical distribution function in position and velocity, $f(r,v)$. This function satisfies a space-dependent equation in which the interaction with the impurities is treated as part of the Hamiltonian and the phonon scattering is described by a linear Boltzmann-type collision term. This equation is solved formally in the presence of a weak external electric field in a form convenient for perturbation expansions in the relative strength of the different scattering mechanisms, some of which are carried out explicitly. It is rigorously shown that the change in conductivity due to the presence of impurities is negative. (auth)

31400 FERMI SURFACE AND POSITRON ANNIHILATION IN SODIUM. A. T. Stewart (Atomic Energy of Canada Ltd., Chalk River, Ont.). Phys. Rev., 123: 1587-8(Sept. 1, 1961).

The angular correlation of photons from positrons annihilating in polycrystalline sodium was measured. The results show two things: In comparison with a free-electron theory, the Fermi surface in Na is probably anisotropic by an amount of the order of 5% of p_F. The probability of annihilation is not very velocity dependent over the range of conduction-electron velocities in Na. This is not inconsistent with the calculations of either Daniel and Friedel or of Kahana. (auth)

31401 ELASTIC CONSTANTS OF CsBr, CsI, RbBr, AND RbI. K. Reinitz (Rensselaer Polytechnic Inst., Troy, N. Y.). Phys. Rev., 123: 1615-19(Sept. 1, 1961).

The elastic constants of two body-centered halides, CsBr and CsI, were determined as a function of temperature at 300 to 73°K. The velocity measurements were obtained with an ultrasonic interferometer constructed according to the design principles of Williams and Lamb. Room temperature constants of RbBr and RbI samples were also measured. The values of C_{11}, C_{12}, and C_{44} in units of 10^{11} d/cm^2 at 22°C for these salts are given in the following table:

	C_{11}	C_{12}	C_{44}
CsBr	3.097	0.903	0.7500
CsI	2.434	0.636	0.6316
RbBr	3.15	0.493	0.384
RbI	2.54	0.407	0.276

The temperature dependence of all the cesium salt constants was negative and nearly linear over the temperature range investigated. It was found that with decreasing temperatures C_{44} increased more rapidly than C_{12} for the two cesium salts examined. The elastic constant data of the sodium chloride type halides, compiled from the literature, are compared with those of the cesium chloride type salts. (auth)

31402 MAGNETIC PROPERTIES OF $KMnF_3$. II. WEAK FERROMAGNETISM. A. J. Heeger, Olof Beckman, and A. M. Portis (Univ. of California, Berkeley). Phys. Rev., 123: 1652-60(Sept. 1, 1961).

The static magnetic properties of single-crystal $KMnF_3$ were studied by magnetic torsion measurements. These measurements are consistent with a transition to uniaxial antiferromagnetism below 88.3°K. Below 81.5°K the magnetic behavior is complex with the development of hysteresis and discontinuities in the torsion. Further, the torsion increases linearly with magnetic field in this range. These observations suggest the development of weak ferromagnetism in this crystal below 81.5°K. From a comparison of the direction of the weak moment and the known distortions in the crystal structure it is concluded that the weak moment results from a canting of the magnetic sublattices because of differences in the sublattice anisotropy. At 81.5° to 88.3° a moment appears only in strong magnetic fields. It is shown that the moment is developed in a field because of the increased parallel susceptibility of a canted antiferromagnet. The canting transition is interpreted as a first order transition of the Jahn-Teller type. The antiferromagnetic transition itself is associated with a change in lattice parameter and is interpreted as an exchange-controlled first-order transition. (auth)

31403 POSITIVE HOLE MOTION AND PHOTOVOLTAIC EFFECTS IN ZINC CADMIUM SULFIDE PHOSPHORS. Hartmut Kallmann, Bernard Kramer, Frank Spagnolo, and Grace Marmor Spruch (New York Univ.). Phys. Rev., 123: 1661-5(Sept. 1, 1961).

Information was gained about the free carriers in activated and unactivated ZnCdS phosphors through a study of the photovoltaic effect in these materials. The photovoltages produced in activated ZnCdS phosphors by illumination with various wavelengths parallel the absorption spectra of these materials and do not depend strongly upon the type of activation. The photovoltages are brought about by a diffusion of electrons from the excited region into the interior of the sample. The addition of lead as a coactivator reduces the voltage because it increases the recombination rate. In unactivated ZnS the size of the photovoltage again parallels the absorption spectrum but its sign is reversed, indicating that positive charges are the more mobile carriers. Unactivated CdS exhibits voltages similar to the activated materials. Insulating one electrode affects the size of the photovoltage appreciably only for the unactivated materials, showing that charge exchange at the electrode is important for them and not for the activated materials. (auth)

31404 SOLUTION OF SCHRÖDINGER EQUATION FOR A PERIODIC LATTICE. Leonard Eyges (Massachusetts Inst. of Tech., Lexington). Phys. Rev., 123: 1673-84 (Sept. 1, 1961).

A new method for solving the problem of one electron in a periodic potential is presented; it is discussed in this paper mainly for k = 0, although it can be generalized to other k. The periodic potential is considered to be generated by spherically symmetric "atomic" potentials at each lattice site; this does not mean of course that the total potential near a lattice site need be spherically symmetric. The method has its origin in the observation that (for k = 0) the equation for $C(K_i)$, the Fourier coefficient of the wave function, becomes just the momentum-space Schrödinger equation when the lattice spacing becomes infinite. This latter equation is separable into a radial part, and an angle-dependent part expressible in spherical harmonics. This suggests that it would be advantageous to expand the $C(K_i)$ for finite lattice spacing similarly, into radial functions $C_l(K_m)$, where K_m is the magnitude of the mth smallest reciprocal lattice vector, and into an angle-dependent part expressible (for cubic lattices) by Kubic harmonics. This is done and the Schrödinger equation for the system becomes a set of homogeneous linear equations for the $C_l(K_m)$, with a corresponding secular determinant for the eigenvalues. The method was tested numerically, as a function of lattice spacing and potential strength, for S-like states, when the "atomic" potentials are exponential ones, and the lattice is body-centered cubic. In many cases it turns out that one can solve the periodic potential case more easily and more accurately than one can solve for the isolated atom. This is because as the lattice spacing gets large the successive K_m became more and more closely spaced and this leads to larger and larger secular equations. The wave functions as well as energies are given for most lattice spacings to considerable accuracy (three to seven significant figures). When the lattice spacing gets large and the equations approach those for the isolated atom, it is shown how one can use the atomic momentum space functions as variational functions, in the same spirit as the usual tight-binding approximation (as applied for k = 0). The present method has the considerable advantage that it bypasses the usual difficulties with that approximation—near-neighbor approximations and calculation of overlap integrals—and permits an easy and accurate evaluation of the variational expression as a sum over the K_m. (auth)

31405 MAGNETIC AND CRYSTALLOGRAPHIC STUDY OF NEODYMIUM-SUBSTITUTED YTTRIUM AND GADO-

LINIUM IRON GARNETS. S. Geller, H. J. Williams, and R. C. Sherwood (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., 123: 1692-9(Sept. 1, 1961).

A study of the garnet systems $\{R_{3-x}Nd_x\}Fe_2Fe_3O_{12}$, R≡Y or Gd, indicates, as expected, that the moment contributed by the Nd^{3+} ion adds to that of the resultant contributed by the iron sublattices, similar to the results of earlier work by others on intermetallic systems involving rare earths and also on Nd- and Pr-substituted yttrium iron garnets. This was explained on the basis that in the L–S ions Nd and Pr, J is generally directed oppositely to S. It was found that the anisotropy introduced by the Nd^{3+} ion prevents saturation at applied fields up to 14,000 oe, and at first a null method involving the garnet system $\{Gd_{2-x}Y_xNd\}Fe_2Fe_3O_{12}$ was used to find the moment contributed by the Nd^{3+} ion at 0°K; the moment obtained by this method is 1.2 μ_B. Subsequently, measurements made to fields of 80,000 oe at 4.2°K on the garnets $\{Y_2Nd\}Fe_2Fe_3O_{12}$ and $\{Gd_2Nd\}Fe_2Fe_3O_{12}$ proved that the extrapolation of n_B vs. $1/H_a$ to $1/H_a = 0$ from the lower field values did not give the proper moments for these compounds. The specimens appeared to be saturated at fields above 70,000 and 60,000 oe, respectively, and gave moments of 6.2 μ_B and 7.7 μ_B, respectively, per formula unit. These values indicate moments for the Nd^{3+} ion of 1.2 μ_B and 1.3 μ_B, respectively. These values corroborate that found by the aforementioned compensation point method. The low value contrasted with the ground-state gJ value of 3.27 μ_B indicates a considerable crystal field effect on the Nd^{3+} ion in the garnets. Maxima have been found for amounts of Nd substitution in Y, Gd, and Sm iron garnets. These data in turn lead to prediction regarding maximum substitution of Nd in other rare-earth iron garnets and also predict a maximum lattice constant close to 12.538 A for any iron garnet, indicating that Pm iron garnet would not exist. Data are given also on some other garnets used to strengthen the conclusions. The garnet $Gd_{1.5}Nd_{1.5}Ga_2Ga_3O_{12}$ may be antiferromagnetic but with a Néel temperature below 1.4°K. Magnetic and crystallographic data are also given on the garnets $\{Gd_{1.5}Er_{1.5}\}Fe_2Fe_3O_{12}$ and $\{Y_{1.5}Er_{1.5}\}$-$Fe_2Fe_3O_{12}$, both of which lead to 5.4 μ_B for the Er^{3+} ion contribution at 0°K, in good agreement with the value deduced from Pauthenet's measurements on erbium iron garnet. (auth)

31406 LAMB SHIFT IN THE HELIUM ATOM. Charles Schwartz (Stanford Univ., Calif.). Phys. Rev., 123: 1700-5 (Sept. 1, 1961).

The calculation, first attempted by Kabir and Salpeter, of the mean excitation energy entering in the Lamb shift of the helium ground state is redone by a quite different approach. A new answer, $\ln[k_0/r_y] = 4.370 \pm 0.004$, leaves theory and experiment on the ionization energy of helium in agreement within the experimental uncertainty of ±0.15 cm^{-1}. Incidental results are given for the electrostatic polarizability of He and H^- ground states and there is appended a new discussion of the construction of higher angular momentum eigenfunctions for the three-body problem. (auth)

31407 EXCHANGE POLARIZATION EFFECTS IN HYPERFINE STRUCTURE. D. A. Goodings (Cambridge Univ., Eng.). Phys. Rev., 123: 1706-14(Sept. 1, 1961).

Exchange polarization of core electrons by outer unpaired electrons was calculated for 10 different atomic configurations of Li, Na, K, F, Cl, Be, B, and N in the unrestricted Hartree-Fock (UHF) approximation. Numerical integration techniques were used and accurate conventional Hartree-Fock (HF) wave functions were also obtained for these configurations. The theory of atomic hyperfine structure in the UHF approximation is developed and the HF and UHF calculated values of the hyperfine coupling constants are compared with available experimental data. The importance of core polarization in solid state problems is briefly mentioned with particular attention to color centers. Finally, unsuccessful attempts to calculate core polarization by perturbation expansion methods are discussed. (auth)

31408 WAVE FUNCTIONS FOR THE FREE ELECTRON. II. THE INCLUSION OF POLARIZATION AND EXCHANGE. R. G. Breene, Jr. (General Electric Co., Philadelphia). Phys. Rev., 123: 1718-23(Sept. 1, 1961).

The effect of the polarization of the atomic core by the free electron on the free-electron wave function and the effect of the exchange of the free electron with the bound orbitals on this wave function are treated by perturbation theory. Polarization must be considered first. Its effect on the atomic charge cloud is introduced through an expansion over the bound wave functions for the atom in terms of the free-electron separation as a parameter. This parametric treatment of electron separation means we cannot accept the solution at small separations from the nucleus although this is not a serious restriction. From this wave function we obtain a polarized Coulomb potential from which a solution for the free-electron function may be obtained using our old programs. Having solved the free-electron wave equation with the exchange potential terms supposed zero, we use this solution to compute the exchange integrals. The equation including these integrals is then solved to obtain approximate wave functions for free electrons containing both exchange and polarization. (auth)

31409 FINE STRUCTURE OF THE K X-RAY ABSORPTION EDGE OF GERMANIUM. J. N. Singh (Washington State Univ., Pullman). Phys. Rev., 123: 1724-9(Sept. 1, 1961).

A double-crystal spectrometer, with a proportional counting system for intensity measurement, was employed for the investigation of the x-ray absorption structure on the high-energy side of the Ge K edge, using 38% polarized x rays on a thin single crystal of germanium in the transmission method. The structure was studied up to 185 ev from the main edge and several new absorption structure features, not reported hitherto, were obtained. These features are satisfactorily explained by Hayasi's theory in the close-in region and by Kronig's theory in the extended region. A significant shift, without any intensity variation, was noted in the extended fine structure on changing the orientation of the single-crystal absorber. A quantitative correlation was made between the observed structures and the theoretically predicted values with a view to testing different theories on absorption fine structure. (auth)

31410 THEORY OF LONG-RANGE INTERATOMIC FORCES. I. DISPERSION ENERGIES BETWEEN UNEXCITED ATOMS. Peter R. Fontana (Yale Univ., New Haven). Phys. Rev., 123: 1865-70(Sept. 1, 1961).

A general theory of second-order dispersion forces between atoms in nondegenerate ground states is first developed by using an irreducible tensor formalism and the theory of angular momentum. This forms the basis for calculations of forces between excited systems. Attention is given to the interaction of two noble gas atoms where it is assumed that each electron oscillates with simple harmonic motion, and the interaction between two alkali atoms is calculated by considering the electrons to be moving in a Coulomb field. The dominant terms of the dispersion energy between a number of atoms and molecules are tabulated. The results indicate that the hitherto neglected dipole-octupole contributions are in many cases larger than the quadrupole-quadrupole terms. (auth)

31411 THEORY OF LONG-RANGE INTERATOMIC FORCES. II. FIRST-ORDER INTERACTION ENERGIES IN THE UNCOUPLED REPRESENTATION. Peter R. Fontana (Yale Univ., New Haven). Phys. Rev., 123: 1871-81(Sept. 1, 1961).

General methods are developed to calculate the matrix elements between two arbitrary states and for any multipole order. The results are expressed in terms of generalized hypergeometric functions. Some delta conditions in the formula for the electrostatic potential allow substantial factorization of the secular determinant. A device called the interaction diagram is introduced to facilitate the ordering of the secular determinant and the classification of the resulting molecular states. The theory is first applied to systems in which spin-orbit effects are neglected. The energy curves between an alkali atom in the ground state and an alkali atom in the first and second excited states, two alkali atoms in the first excited state, and an alkali atom in the first and another in the second excited state are calculated. In the last case, where some matrix elements consist of more than one multipole term, the competition of multipoles leads to energy curves which have maxima and minima in first order. It is also shown that for the interaction between atoms in excited states the resonance forces are less dominant while configuration interactions and the forces obtained from simple product state functions become more and more important. (auth)

31412 UNIMPORTANCE OF SURFACE ROUGHNESS UPON THE KAPITZA RESISTANCE. W. A. Little (Stanford Univ., Calif.). Phys. Rev., 123: 1909-11(Sept. 15, 1961).

A proof is given which shows that surface roughness which is less than the phonon mean free path can only increase the Kapitza resistance between liquid helium and a solid; and that this change in resistance is small. (auth)

31413 GENERALIZED BARDEEN-COOPER-SCHRIEFFER STATES AND THE PROPOSED LOW-TEMPERATURE PHASE OF LIQUID He^3. P. W. Anderson (Bell Telephone Labs., Inc., Murray Hill, N. J.) and P. Morel. Phys. Rev., 123: 1911-34(Sept. 15, 1961).

Particle interactions in a Fermi gas may be such as to attract pairs near the Fermi surface more strongly in $l = 1, 2, 3$ or higher states than in the simple spherically symmetrical s state. In that case the Bardeen-Cooper-Schrieffer condensed state must be generalized, and the resulting state is an anisotropic superfluid. Properties of this type of state were studied in considerable detail, especially for $l = 1$ and 2. Expressions were derived for the energy, the moment of inertia, the magnetic susceptibility and the specific heat. The density correlation function and the density-current density correlation are also derived; in some cases the latter implies that the liquid has net surface currents and a net orbital angular momentum. The ground state for $l = 2$ is different from those previously considered, and has cubic symmetry and no net angular momentum. A general method for replacing the possibly rather complicated potential by a simple scattering matrix is given. A discussion of possible collective effects is included. Results are applied to liquid He^3; after correction for scattering by a method due to Suhl, it is found that the predicted transition should take place below 0.02°K. Other possible applications are suggested. (auth)

31414 ORIGIN OF EFFECTIVE FIELDS IN MAGNETIC MATERIALS. R. E. Watson (Avco, RAD. Wilmington, Mass.) and A. J. Freeman. Phys. Rev., 123: 2027-47 (Sept. 15, 1961).

The origin of the effective magnetic fields at the nuclei of magnetic materials determined by Mössbauer, nuclear magnetic resonance, electron paramagnetic resonance, specific heat, and nuclear polarization methods is investigated theoretically by means of the exchange polarization mechanism. Exchange-polarized iron series Hartree-Fock calculations were carried out for free ions and neutral atoms, ions in a (crude) crystalline field (as in a salt), and spin densities and configurations which conform with energy band and neutron magnetic scattering observations for the ferromagnetic metals. The effective field data for metals, ferrites, rare-earth garnets, and salts are then discussed and it is shown that the dominant contribution to the effective field (in almost every case) arises from the (exchange) polarization of the core electrons by the spin density of the unpaired outer electrons. For the transition metals, the role of the conduction electrons is analyzed including some new contributions not previously considered. The data for ions like Fe^{3+} and Mn^{2+} may be understood mainly on the basis of the core polarization term but such factors as covalent bonding, charge transfer, crystal field effects (such as distortions from cubic symmetry) must also be included. For ions like Fe^{2+} and Co^{2+} the (large) field due to unquenched orbital angular momentum must also be considered and several cases in which the orbital field dominates are discussed. The exchange polarization method and the accuracy of the analytic spin-polarized Hartree-Fock functions are discussed with regard to the sensitivity of the internal field to orbital descriptions, the effect of crystalline environments, and to expansion and contraction of the spin density. Each factor is investigated in detail by means of accurate exchange-polarized calculations. In conjunction with these studies a restricted Hartree-Fock calculation for Mn^{2+} was carried out (and is reported as an Appendix) which is more accurate than existing calculations and indicates the accuracy of earlier analytic Hartree-Fock calculations. (auth)

31415 SPECTRAL DIFFUSION IN ELECTRON RESONANCE LINES. W. B. Mims, K. Nassau, and J. D. McGee (Bell Telephone Labs., Inc., Murray Hill, N. J.). Phys. Rev., 123: 2059-69(Sept. 15, 1961).

Spectral diffusion in the inhomogeneous paramagnetic resonance lines of Ce^{3+} and Er^{3+} in $CaWO_4$ at concentration $\sim 10^{18}$ spins/cc was studied by electron spin echo techniques. Measurements show that the spreading of excitation through the line can be approximately described by a diffusion kernel in the form of a Lorentzian function whose width is linear in time. Local field fluctuations due to spin-spin flips and spin-lattice flips appear to be the primary cause of diffusion. In $(Ca,Ce)WO_4$ below 4.2°K the lattice time is long, and spin-spin flips predominate, leading to a diffusion rate which is independent of temperature. In $(Ca,Er)WO_4$ lattice relaxation is more rapid, and the diffusion parameter varies as the lattice time. Nuclei of W^{183} in the host crystal were observed to give a modulation in the envelope of spin echoes, but the corresponding local fields are smaller than those arising from electron spins at the concentrations studied. (auth)

31416 SPUTTERING OF POLYCRYSTALLINE METALS BY INERT GAS IONS OF LOW ENERGY (100-1000 eV). C. H. Weijsenfeld, A. Hoogendoorn, and M. Koedam (Universiteit, Utrecht). Physica, 27: 763-4(Aug. 1961). (In English)

Cathode sputtering yields are reported for polycrystalline copper, iron, molybdenum, and nickel bombarded with monoenergetic argon, krypton, neon, and xenon positive ions having energies ranging from 100 to 1000 ev. The sputtering yields are calculated from the weight loss of a 0.7 cm diameter spherical target, immersed in a low pressure plasma, and from the quanity of charge arriving on the target. The

ion current density amounted to about 1.5 ma/cm^2. The measured yields are independent of ion current density and sputtering time; this means that there is no considerable influence of surface impurities. (N.W.R.)

31417 PREPARATION OF PLASTIC SCINTILLATORS. M. Ya. Balats, V. V. Krivitskii, G. A. Leksin, and Yu. V. Trebukhovskii. Pribory i Tekh. Ekspt., 6: No. 2, 171 (Mar.-Apr. 1961). (In Russian)

Preparation of polystyrol-terphenyl scintillator under 100 to 200 g/cm^{-2} pressure at 140 to 150°C is described. (R.V.J.)

31418 GRAPHIC METHOD FOR PARTICLE ENERGY TRANSFORMATION FROM LABORATORY COORDINATE SYSTEM INTO MOVING SYSTEMS. Yu. I. Serebrennikov (Leningrad Polytechnic Inst.). Pribory i Tekh. Ekspt., 6: No. 2, 172-3(Mar.-Apr. 1961). (In Russian)

A diagram for converting the angular distribution and energy of a large number of emitted particles into rate of motion is shown at transition rate of $1 \times 10^8 < v \leq 5 \times 10^9$ cm/sec. Two diagrams are plotted for α particles and for protons at $v = 3.5 \times 10^8$ cm/sec in Mev units. (R.V.J.)

31419 ZIRCONIUM TARGET WITH COPPER AND SILVER BASE. V. I. Petrov. Pribory i Tekh. Ekspt., 6: No. 2, 174-6(Mar.-Apr. 1961). (In Russian)

Preparations of tritium- or deuterium-saturated zirconium targets with copper and silver base are described. The zirconium foil is soldered to copper by a thin layer of silver. The technology of the copper-base layer with spiral cooling channels was developed. The zirconium and silver layer are connected by silver casting in vacuum. The mean atomic ratio of tritium to zirconium with copper base is ~1.4 and with silver ~1.8. (tr-auth)

31420 LUMINESCENCE TIME OF PLASTIC MASS SCINTILLATORS. E. E. Baroni, S. F. Kilin, K. A. Kovyrzina, I. M. Rozman, and V. M. Shoniya. Pribory i Tekh. Ekspt., 6: No. 3, 72-4(May-June 1961). (In Russian)

The luminescence time and relative luminescence yield of plastic scintillators with polystyrene and polyvinyltoluene were measured. It is shown that the fast action of some of the examined plastic scintillators exceeds that of stilbene. (tr-auth)

31421 INTERACTIONS OF HYDROMAGNETIC WAVES. V. V. Gogosov. Priklad. Mat. i Mekhan., 25: 456-67(May-June 1961). (In Russian)

Interactions of magnetodynamic waves with rarefications, other waves, and plane ideally conducting walls were investigated. The medium was assumed to be ideally conducting, and the parameters were not limited. (R.V.J.)

31422 ON THE SHAPE OF A GENERALIZED OHM LAW IN COMPLETELY IONIZED GAS. V. B. Baranov and G. A. Lyubimov. Priklad. Mat. i Mekhan., 25: 468-72 (May-June 1961). (In Russian)

Equations are developed for a generalized Ohm's law, and dimensionless criteria are written for a completely ionized gas. (R.V.J.)

31423 SHOCK WAVE PROPAGATION IN ELECTROMAGNETIC FIELD WITH DISRUPTED CONDUCTIVITY. V. P. Karlikov and V. P. Korobeinikov. Priklad. Mat. i Mekhan., 25: 554-6(May-June 1961). (In Russian)

Electromagnetic emission from strong spherical shock waves propagated in weak magnetic and electric fields was studied under the assumption that the mechanism of electromagnetic excitation is related to a conductivity jump induced by the shock wave. (R.V.J.)

31424 ON THE ROTATION OF CONDUCTING FLUID IN ANNULAR APPERTURE IN PRESENCE OF TRANSVERSE MAGNETIC FIELDS. Ya. S. Uflyand. Priklad. Mat. i Mekhan., 25: 557-60(May-June 1961). (In Russian)

The steady motion of a viscous, conducting, incompressible fluid in a space confined between two infinite cylinders is studied, assuming a nonconducting internal cylinder that rotates at constant angular velocity while the external cylinder is stationary. An external, homogeneous magnetic field is perpendicular to the cylinder axes. (R.V.J.)

31425 WAVE BRANCHING PROCESSES AND INVARIANT IMBEDDING. [PART] I. Richard Bellman and Robert Kalaba (RAND Corp., Santa Monica, Calif.). Proc. Natl. Acad. Sci. U. S., 47: 1507-9(Sept. 1961).

A method of using invariant imbedding and the principle of localization to treat wave processes in which there is creation and destruction of waves is indicated. A new mathematical formulation of wave processes, which overlaps with the conventional one in the case of deterministic linear processes and can serve as a definition of the physical process in the stochastic and nonlinear cases, is presented. (P.C.H.)

31426 THE STATISTICAL PROPERTIES OF SEQUENCES OF STOCHASTIC PULSES. T. Lukes (Northampton College of Advanced Tech., London). Proc. Phys. Soc. (London), 78: 153-68(Aug. 1961).

Two methods are presented for treating sequences of random pulses which are applicable to cases where the distribution of periods, durations, or intervals is known. The methods are shown to lead to identical results and enable the correlation functions, after-effect functions, and spectra to be calculated. The results are applied to typical sequences; some existing results are shown to be particular cases of the theory presented. (auth)

31427 ENERGY LEVELS IN THE FORBIDDEN GAP OF INSULATING DIAMONDS. R. R. Urlau, H. J. Logie, and F. R. N. Nabarro (Univ. of Witwatersrand, Johannesburg). Proc. Phys. Soc. (London), 78: 256-74(Aug. 1961).

Two type I diamonds and one type IIa have been examined for the following properties: counting of beta particles in the dark, counting under space charge, effect of monochromatic illumination on counting under an applied field and under space charge, change of total charge while counting and while conducting, and photoconductivity. On the basis of these observations and of the known optical absorption of diamonds of these types a preliminary level scheme is proposed as follows: A level exists 0.94 ev above the valence band. This level provides traps for holes, and is normally filled, but gives rise to photoconductivity after exposure to electron bombardment or irradiation with energetic ultra-violet light. A level exists 1.6 ev above the valence band. This level also provides traps for holes and is tentatively identified with the Kaiser-Bond nitrogen level. A level exists 3.3 ev above the valence band. This level is partly filled and provides traps for electrons. It can give rise to either n- or p-type photoconductivity. (auth)

31428 QUANTUM THEORY OF MAGNETORESISTANCE. I. LOW FIELDS. R. B. Stinchcombe (Univ. of Birmingham, Eng.). Proc. Phys. Soc. (London), 78: 275-92(Aug. 1961).

The conventional treatment of magnetoresistance is based upon the Boltzmann equation for a distribution function f(k), and an equation which gives the average current in terms of f(k). With the usual definition of f(k) neither equation is exact: the derivation of the Boltzmann equa-

tion requires $\omega\tau < 1$, where ω is the cyclotron frequency and τ is the relaxation time. A representation is proposed which exploits the properties of homogeneous systems in a uniform magnetic field. f(k) is redefined as the diagonal element of the density matrix in the new representation. Then the usual equation for obtaining the current becomes exact. Proceeding from the equation of motion of the density matrix, a weak-coupling derivation of the Boltzmann equation is given in the manner used by Kohn and Luttinger in 1957 for field-free systems. The derivation is restricted to the case of non-interacting carriers elastically scattered by impurities or lattice vibrations, and moving in a lattice which in the absence of the magnetic field gives rise to non-overlapping bands. The conductivity yielded by this method is found to be accurate as long as $\hbar\omega$, $\hbar/\tau$ are small compared with the Fermi energy, and $\hbar\omega$ is less than the thermal energy. The condition $\omega\tau < 1$ does not arise. (auth)

31429 A STUDY OF SUPERCONDUCTING NIOBIUM BY ELECTRON TUNNELLING. P. Townsend and J. Sutton (Caswell Research Labs., Towcester, Northants, Eng.). Proc. Phys. Soc. (London), 78: 309-11(Aug. 1961).

Current-voltage characteristics of sandwiches composed of bulk niobium separated by a thin film of niobium oxide are investigated and reported as functions of temperature and magnetic field. It was desired that the niobium oxide be continuous at thicknesses of about 20Å and of high resistivity. The bulk niobium was shown to be superconducting at 4.2°K. (L.N.N.)

31430 HYPERFINE STRUCTURE IN TERBIUM METAL. B. Bleaney and R. W. Hill (Claredon Lab., Oxford). Proc. Phys. Soc. (London), 78: 313-15(Aug. 1961).

The hyperfine contribution to the specific heat of terbium metal as previously measured (NSA, 12: 13803) was smaller than that expected from electron paramagnetic resonance experiments (NSA, 12: 11160). It is shown that this discrepancy may be resolved when the electric quadrupole interaction with the Tb^{159} nucleus is considered. (L.N.N.)

31431 THE THEORY OF SUPERCONDUCTIVITY IN THE TAMM-DANCOFF APPROXIMATION. B. P. Nigam (Univ. of Rochester, N. Y. and General Dynamics/Electronics, Rochester, N.Y.). Progr. Theoret. Phys. (Kyoto), 25: 436-40(Mar. 1961). (NYO-9544) (In English)

The Tamm-Dancoff approximation is applied to the interaction Hamiltonian used in the Bogoliubov theory of superconductivity. It is shown that essentially the same compensating equation as obtained by Bogoliubov results from either the requirement that no virtual production of electron-hole pairs occurs without phonons, or the requirement that the electron-phonon coupling parameter tends to zero. (auth)

31432 ON THE THEORETICAL STUDIES OF TWO-ELECTRON TRANSITIONS IN Th^+. I. V. Chiplis and K. K. Ushpalis (Inst. of Physics and Mathematics, Academy of Sciences, Lituanian SSR). Trudy Akad. Nauk Litov. S.S.R., Ser. B, No. 2, 31-9(1961). (In Russian)

Two-electron transitions $6d^27s(^2G, ^2F, ^2D) \rightarrow 7s^25f(^2F)$ in singly ionized thorium were studied by the method of incomplete separation of variables and by monoconfiguration approximation. Numerical values are found for total dipole power, oscillator power, and transition probability. (tr-auth)

31433 SENSITIZED LUMINESCENCE IN ALKALI HALIDE CRYSTALS ACTIVATED WITH MERCURY-LIKE ACTIVATORS AND MANGANESE. K. K. Shvarts and U. A. Zirnitis. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R., No. 11, 3-28(1960). (In Russian)

In the phosphor KCl–Tl, Pb the luminescence of Pb^{2+} may be observed on excitation of Tl^+. The transfer of energy is conditioned by reabsorption. In phosphors with KCl and NaCl matrix material the possibility of the transfer of energy from Tl^+, In^+, Ga^+, Pb^{2+}, Sn^{2+} to Mn^{2+} was examined. The effective transfer of energy to Mn^{2+} was observed only from Pb^{2+} in KCl and from Pb^{2+}, Tl^+, and In^+ in NaCl. It is shown that the phenomenon of sensitized luminescence in the systems KCl–Pb, Mn and NaCl–Pb, Mn is due to local concentrations of Pb and Mn in some regions. Hence the effect of sensitization in these systems greatly depends on the physico-chemical state of the crystal phosphor. (auth)

31434 ON THE INFLUENCE OF SOME PHYSICO-CHEMICAL FACTORS ON THE OPTICAL FLASH OF LUMINESCENCE IN ALKALI HALIDE PHOSPHORS. P. A. Khellenurme. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R., No. 11, 116-29(1960). (In Russian)

The influence of some physico-chemical factors on the optical flash stimulation spectra of KCl–Tl was studied. It is shown that by changing the concentration of the activator, a redistribution of the intensities of the bands in the optical flash stimulation spectrum takes place, the different traps having different optimum concentrations of the activator. The spectral sensibility of the phosphor KCl–Tl toward infrared light is decreased by adding divalent non-activating impurities and increased by the plastic deformation of the crystal. The measured optical flash stimulation spectra in the homologous series of the alkali halide phosphors activated with thallium are presented. (auth)

31435 NOTES ON THE INVESTIGATION OF ELECTRON-HOLE RELAXATION PROCESSES IN CRYSTAL PHOSPHORS. Kh. F. Kyaembre and C. B. Lushchik. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R., No. 11, 150-79(1960). (In Russian)

Electron-hole relaxation processes are studied and optical, electric, and magnetic characteristics during crystal excitation and de-excitation are investigated. 113 references. (R.V.J.)

31436 ABSORPTION OF WAVES WITH FINITE AMPLITUDE IN A CONDUCTING MEDIUM. Yu. F. Filippov (Khar'kov Inst. of Radiophysics and Electronics, Academy of Sciences, Ukrainian SSR). Ukrain. Fiz. Zhur., 6: 248-54(Mar.-Apr. 1961). (In Ukrainian)

Magnetohydrodynamic equations are solved for an infinite medium for the case of small nonlinearity. It is shown that the propagation of magneto-sound waves in an ideal conducting medium leads to distortion of the front and discontinuity. The distortion increases considerably the factor of absorption for the case of a viscous and thermoconducting medium. (auth)

31437 ELECTRON CAPTURE AT ATOMIC COLLISIONS. CALCULATION OF ELECTRON CAPTURE BY PARAMETER METHOD. Yu. E. Murakhver. Vestnik Leningrad. Univ., 16: No. 4, Ser. Fiz. i Khim. No. 1, 5-18(1961). (In Russian)

Molecular and atomic approximations for electron capture were correlated, and a formula for high-velocity perturbation was developed. The parameter method was applied in investigating some examples of resonance electron capture. One-electron approximation was used for determining the energy dependence of one-electron capture cross sections. Analogous results were obtained with two- and three-electron approximations for double and triple electron capture. Energy transfer effects are considered in one-electron calculations and the results are generalized for high velocities. (R.V.J.)

31438 MULTI-ATOMIC MOLECULAR IONS IN HIGH FREQUENCY SPARKS BETWEEN ELECTRODES FROM THE ELEMENTS Be, C, Mg, Al, Ti, Fe, AND Cu. J. Franzen and H. Hintenberger (Max-Planck-Institut für Chemie, Mainz). Z. Naturforsch., 16a: 535-9(June 1961). (In German)

With the exception of boron, in all the elements investigated multi-atomic molecular ions were detected in a high-frequency spark. In addition to carbon and the other elements of the fourth group of the periodic table, aluminum and especially beryllium are strongly inclined to the formation of multi-atomic molecular complexes. In aluminum the ion Al_7 occurs with preferable frequency. In beryllium not only Be atoms occur alone, but also Be atoms combined with oxygen atoms in multi-atomic complexes, of which the $Be_{n+1}O_n$ complex is distinguished by preferable frequency. (tr-auth)

31439 THE TIME PATTERN OF THE CURRENT OF A TOWNSEND DISCHARGE IN UNIFORM FIELDS. R. Kluckow (Universität, Hamburg). Z. Naturforsch, 16a: 539-47(June 1961). (In German)

The transient growth of currents in a Towsend gas discharge system under uniform d-c field conditions is calculated by means of the theory given by Auer. Three cases are examined in detail: (1) The discharge is initiated by a short UV light pulse releasing a great number of electrons from the cathode; (2) The discharge is started by a single electron; and (3) The discharge develops under constant external illumination producing a great number of electrons within a period of an electron transit time. Earlier experimental work is discussed on the basis of the calculated relations. (auth)

31440 ANGULAR DISTRIBUTION OF THE HYDROGEN AND ARGON IONS FROM A HIGH FREQUENCY ION SOURCE. H. Löb and S. Peyerimhoff (Universität, Giessen, Ger.). Z. Naturforsch., 16a: 621-4(June 1961). (In German)

It has been established that the ions from a high-frequency ion source exit at a larger angle than in most other ion sources. In the present study the angular distribution of the ions is investigated in some detail, especially in dependence on the operating conditions and the geometry. In the explanation of the results, ions are considered which arise through potential change in the area between the plasma boundary and extraction cathodes. The measurements were made with argon and hydrogen ions since the energy distribution and the site of origin of these ions is accurately known. (J.S.R.)

31441 ABSORPTION OF DEUTERIUM BY ALUMINUM CATHODES IN THE GASEOUS DISCHARGE. A. A. Rodina. Zhur. Fiz. Khim., 35: 1657-60(Aug. 1961). (In Russian)

Deuterium absorption by aluminum cathodes during electric discharge in a strong magnetic field was investigated for discharge voltages up to 5000 v. It is shown that considerable concentrations of deuterium can thereby be established in the thin surface layer of the metal. Absorption begins only after breakdown of the thin passive oxide film. Heating accelerates film breakdown and increases gas absorption. (auth)

31442 STATISTICAL THERMODYNAMICS OF POINT ELECTRICAL CHARGES. I. Z. Fisher, A. M. Zaitseva, and V. K. Prokhorenko (Belorussian State Univ., USSR). Zhur. Fiz. Khim., 35: 1877-8(Aug. 1961). (In Russian)

A system of point charges in which the general charge is neutralized by an evenly distributed background is analyzed. The results may be utilized for a wide range of temperatures and densities. (R.V.J.)

31443 IONIZATION OF ARGON BY OXYGEN AND NITROGEN IONS. R. N. Il'in and E. S. Solov'ev (Leningrad Inst. of Physics and Tech.). Zhur. Tekh. Fiz., 31: 680-7(June 1961). (In Russian)

The total ionization cross sections (σ_-), total electron capture cross sections (σ_0), and the cross sections of secondary argon ions (σ_{0n}) are measured for the N^+, O^+, N_2^+, O_2^+, NO^+, and NO_2^+ ions with energy of 15 to 180 kev in argon. It was found that the total ionization cross section σ_- and cross sections of two-, three-, and four-charge argon ion formation (σ_{02}, σ_{03}, and σ_{04}) increase with the increase of the number of atoms participating in the primary ion composition. The bond between the two-electron capture process resulting in $O^+ \rightarrow O^-$ transition and production of multicharged ions was found. (R.V.J.)

31444 ELECTRON PARAMAGNETIC RESONANCE OF SOME TYPES OF CARBON BLACKS. N. S. Garif'yanov, A. V. Il'yasov, and Yu. M. Ryzhmanov (Inst. of Physics and Tech., Academy of Sciences, Kazan Branch, USSR and Kazan Inst. of Organic Chemistry, Academy of Sciences, USSR). Zhur. Tekh. Fiz., 31: 694-8(June 1961). (In Russian)

Electron paramagnetic resonance in various types of thermally treated carbon blacks was investigated at various frequencies and at temperatures from −193 to 300°C. (R.V.J.)

31445 RÖNTGENOGRAPHY INVESTIGATION OF LIGHT SUBSTANCES COMPRESSION BY SLANTING COLLISION OF SHOCK WAVES. L. V. Altshuler and A. P. Petrunin. Zhur. Tekh. Fiz., 31: 717-25(June 1961). (In Russian)

The x-ray method of investigation of regular inclined reflection and slanting shock wave collisions in solids and liquids is described. The method is designed for determining pressures and densities in the step-like double compression region behind reflected shock waves. The tests used light metals (magnesium and aluminum) and light-atom compounds transparent to x radiation (water, paraffin, and plexiglas). High densities and pressures of 600,000 to 900,000 atm. exceeding several times the pressure of shock waves before collision were recorded in the reflection area of all the materials examined. (tr-auth)

31446 ON NON-EQUILIBRATE GAS-MIXTURE DISSOCIATION BEHIND SHOCK WAVES. Yu. P. Lun'kin and F. D. Popov (Leningrad Inst. of Physics and Tech.). Zhur. Tekh. Fiz., 31: 726-30(June 1961). (In Russian)

Nonequilibrate dissociation of two-component gas mixtures behind a straight shock wave is investigated. A previously developed approximation equation describing nonequilibrate dissociation of a pure diatomic gas behind the shock wave is corrected and generalized for the case of a two-component mixture consisting of diatomic or monatomic gases. (R.V.J.)

31447 DIFFRACTION OF DETONATION WAVES AT THE INCIDENCE ON THE BOUNDARY DIVIDING TWO GAS MIXTURES. L. G. Gvozdeva (Krzhizhanovskii Power Inst., Moscow). Zhur. Tekh. Fiz., 31: 731-9(June 1961). (In Russian)

Refraction of detonation waves in transition from one explosive mixture to another is discussed. The process at the detonation wave approach to the boundary surface of the mixture capable of reaction with inert or explosive mixtures was photographed by high-speed photography. (R.V.J.)

31448 DIFFUSION OF DEUTERIUM IONS INTO METALS. V. M. Gusev, M. I. Guseva, N. P. Elistratov, and D. S. Ikonnikov (Sukhumi Inst. of Physics and Tech., Academy of Sciences, Georgian SSR). Zhur. Tekh. Fiz., 31: 749-50(June 1961). (In Russian)

Deuterium saturation curves are plotted for the targets Ag, Al, Au, Pt, Ta, Ti, and stainless steel. The largest number of deuterium atoms are absorbed on Ti (14 times larger than into stainless steel, which absorbs the lowest amount). The total neutron yield from a titanium target irradiated by 25-kev deuteron beam is 2.5×10^6 n/sec from a 1 cm^2 wall. (R.V.J.)

31449 INTENSE PULSE ELECTRON BEAM PASSAGE THROUGH DIELECTRIC TUBES. A. K. Berezin, V. G. Stupak, L. I. Bolotin, G. P. Berezina, Yu. M. Lyapkalo, and Yu. N. Sevryukov (Khar'kov Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Tekh. Fiz., 31: 751-3(June 1961). (In Russian)

The diagram of electron pulse beam passage through a dielectric tube shows two groups of electrons (the fast electron group and the slow electron group) while electron passage through a metal tube exhibits only fast electrons. Experiments were made for determining the time of slow electron appearance in a given energy beam. The time was calculated from the initial pulse intensity on the electron gun. A graph is shown of the slow electron time of appearance at the analyzer outlet as a function of the energy. The dependence of slow electron energy spectra on the primary electron beam pressure, intensity, and velocity is determined. (R.V.J.)

31450 FUNDAMENTAL DATA OBTAINED FROM SHOCK-TUBE EXPERIMENTS. A. Ferri, ed. New York, Pergamon Press, 1961. 426p. $12.00.

Fundamental data are presented on chemical, physical, and thermodynamic problems investigated or investigable experimentally by shock-tube techniques. Information is also presented on unsteady flow motion and shock-tube techniques. Applications, describing specific investigations in the fields of chemical physics and thermodynamics where shock-tube techniques were used, are also presented. (N.W.R.)

31451 ON PERSPECTIVES IN OPTICAL ANALOG CALCULATIONS. P. Braffort (Centre de Traitement de l'Information Scientifique). p.109-10 of "Seminar on Analogue Methods in Nuclear Energy Problems, Actes—Proceedings, Brussels, April 21-23, 1960." Brussels, Presses Academiques Europeennes, 1961. (In French)

The possibilities for use of optical information in analog systems as opposed to electrical or mechanical signals are explored. These optical models exist in two principal types, a) those based on Lambert's law, and b) linear filters which transform a function and its composition product to another function. (T.R.H.)

Astrophysics and Cosmology

31452 (ARF-1176-4) WAVE PROPAGATION UNDER ANOMALOUS CONDITIONS. Quarterly Report No. 2. C. M. Haaland (Illinois Inst. of Tech., Chicago. Armour Research Foundation). July 13, 1961. Contract DA 36-039 SC-87199. 24p.

A model for the chemosphere is considered, in a state that is slightly ionized by e. g. solar flares or a nuclear explosion. It is found that two reactions are necessary in addition to those previously ascertained, in order that NO^+ rather than NO_2^+ be the principal positive ion. The reaction rates for positive ions at 65 and 110 km are investigated. At 65 km the positive ions, in order of decreasing importance at equilibrium, are predicted to be NO^+, O_2^+, O^+ or O_3^+, N_2^+, and N^+ or NO_2^+. The order is unpredictable at 110 km, because of uncertainties in the estimated rate coefficients. In this altitude range, however, the equilibrium electron density, determined by $(s_e/\alpha)^{1/2}$, depends only upon α, the dissociative recombination coefficient of electrons with NO^+, and not on the similar coefficient for other ions. (s_e is the source strength in electron-ion pairs generated/$cm^3 \cdot$ sec). Analytical solutions are given for the three-equation model with the source strength function expressed in such a form that many cases of decay vs. time can be approximated. (T.F.H.)

31453 (NP-10753) THE REFLECTION OF RADIO WAVES FROM AN IRREGULAR IONOSPHERE. Technical Report No. 382. M. L. V. Pitteway (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics). Nov. 8, 1960. 28p.

Recent research on the reflection of radio waves from an irregular ionosphere is extended to strong scattering. Solutions of the wave equation for a horizontally stratified ionosphere are used, and the equations governing scattering for a simple two-dimensional model are written in a coupled form. A ray theory of scattering is examined from a wave theory viewpoint, applied to scattering by an irregular layer of free electrons. Limited results of numerical work are given graphically. (auth)

31454 (NP-10764) ASTRONAUTICS INFORMATION. Open Literature Survey, Vol. IV, No. 2. Entries 40,203-40,453. (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Aug. 1961. NASw-6. 41p.

An annotated bibliography is presented consisting of 251 references to literature applicable to data and techniques in space flight. (B.O.G.)

31455 (NP-tr-747) THE UPPER ATMOSPHERE AND INTERPLANETARY MEDIUM. V. G. Kurt. Translated from Priroda, 50: No. 2, 23-30(1961). 23p.

A review of information on astrophysics is presented. Included are discussions on the upper atmosphere, the terrestrial corona, and interplanetary space. (J.R.D.)

31456 THE HEATING OF THE SOLAR CHROMOSPHERE, PLAGES, AND CORONA BY MAGNETOHYDRODYNAMIC WAVES. Donald E. Osterbrock (Institute for Advanced Study, Princeton, N. J.). Astrophys. J., 134: 347-88(Sept. 1961).

The energy radiated from the chromosphere, corona, and upper chromosphere is estimated from observational data. The energy carried upward by sound waves generated in the hydrogen convection zone is estimated and found sufficient to balance these losses, though the numerical result is uncertain because of its dependence on the turbulent velocity field. The spectrum of this noise is a broad band with maximum near the frequency of 0.01 cps. The waves propagate in the fast mode and become increasingly magnetohydrodynamic in the chromosphere, because of the negative density gradient. Little, if any, energy is emitted by the hydrogen convection zone in the slow or Alfvén modes, and these modes are strongly absorbed in the photosphere. The cross-section for collisions between neutral atoms and ions in the chromosphere is large, and the dissipation of the fast-mode waves by the frictional damping mechanism is very small. The waves build up to shocks, and the dissipation of these shocks is the main energy source for the chromosphere. The dissipation of the shocks is in a way analogous to the Brinkley-Kirkwood theory of the dissipation of pure gas-dynamic shocks. At great heights, where the magnetic field dominates, the shocks become weaker, the dissipation decreases, and the rays are refracted back downward toward the photosphere. However, at these heights, collisions between shocks must

be expected to feed some energy into the slow mode and the Alfvén mode, and these modes then propagate straight up the magnetic line of force, with essentially no weakening by refraction, and carry energy into the corona. The plages are regions of larger magnetic field, where there is extra generation of noise in the hydrogen convection zone below and where the refraction and shock-collision effects are more important. The spicules seen at the limb of the sun are interpreted as slow-mode disturbances carrying chromospheric material up along the magnetic lines of force into the corona. (auth)

31457 INTERPLANETARY GAS. V. A HYDROGEN CLOUD OF TERRESTRIAL ORIGIN. John C. Brandt (Carnegie Institution of Washington, D. C. and California Inst. of Tech., Pasadena). Astrophys. J., 134: 394-400 (Sept. 1961).

Evidence is presented which indicates that the nighttime Lyman-α observations can be attributed to solar radiation scattered by a cloud of hydrogen of terrestrial origin located at geocentric distances greater than about 5 to 10 earth radii. It also appears that the earth has a comet-like tail of hydrogen in the antisolar direction. (auth)

31458 THEORY OF AURORAL BOMBARDMENT. Joseph W. Chamberlain (Yerkes Observatory, Williams Bay, Wis.). Astrophys. J., 134: 401-24(Sept. 1961).

An auroral theory is developed of particle orbits in an inhomogeneous plasma confined by a magnetic field. Specifically, a mechanism is proposed for ejection into the atmosphere of geomagnetically trapped protons and electrons. It is assumed that the energetic particles are distributed in longitude irregularly. The tendency for positive and negative particles to drift in opposite directions will then lead to momentary electrostatic fields, arising from excess charges of one sign aligned along a magnetic line of force. As particles drift into this potential, they lose transverse kinetic energy, and a portion of the particles immediately spiral out the ends of the flux tube into the atmosphere. As the potential grows, the drift of particles into this discharge tube is inhibited, but more of those entering the potential with high velocity are ejected, regaining their lost transverse kinetic energy in accelerated motion along the magnetic field. If the density fluctuations of auroral plasma exceed a certain critical value, the electrostatic field will cause them to grow rapidly. The basic mechanism of electrostatic fields arising from the particle drifts will also produce local accelerations of particles, by tending to establish an equipartition of energy between protons and electrons. This is presumably the mechanism for the local acceleration of auroral electrons, although it will also modify, but less severely, the energy spectrum of trapped protons. Various other consequences of these macroscopic, but short-lived, electric fields are examined, with a view toward understanding auroral morphology. It is proposed that an $E \times B$ drift accounts for the statistical preference for auroral patterns to move toward the sunlit hemisphere and for the departures of auroral forms from alignment along circles of geomagnetic latitude, even in the polar cap. The E field, when transferred to the atmosphere by bombardment and by ordinary conduction, will produce a Hall current parallel to auroral motions; this current is identified with the auroral electrojet and associated magnetic disturbances. It is suggested that these considerations also have a bearing on the north-south thickness of auroral forms, on auroral breakup, and on daily variations. (auth)

31459 ON THE ORIGIN OF LUNAR RAYS. Gilbert Fielder (Univ. of London Observatory). Astrophys. J., 134: 425-34(Sept. 1961).

Theoretical curves of the variation of intensity along a single ray were constructed and compared with the observational curves of Graff. The comparison lends support to the theory that ray-forming particles were projected with velocities varying between the limits $0.7 \lesssim V \lesssim 1.5$ km sec^{-1}, and at elevations to the horizontal of $2° \lesssim \theta \lesssim \Theta$, where Θ defines a zone of avoidance, which, by analogy with explosion models, was possibly limited to $20° \lesssim \Theta \lesssim 40°$. Insufficient support can be found for Giamboni's theory that the elliptical ray which runs from Tycho toward Bullialdus was formed by particles shot into both low-angle and high-angle zones, the two sets of particles then being separated out in azimuth by the rotation of the moon. Objections to this theory are listed. The theory is consistent with independent evidence, which showed clearly that particles were ejected from ray craters mostly at fairly small angles to their tangent planes. (auth)

31460 PRODUCTION OF NEON IN STARS. H. E. Gove, A. E. Litherland, and M. A. Clark (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nature, 191: 1381-2(Sept. 30, 1961).

Certain measurements of the properties of some levels in neon-20, which are related to the production of neon in stars, are reported. Special attention is given to the 4.97 Mev level, which has odd parity and $J = 2$, and the helium thermonuclear reactions at 5.63 Mev. Evidence of the $J\pi = 2-$ by $\alpha - \gamma$ correlations in the carbon-12 ($C^{12}\alpha$) neon-20 reaction, and of the formation of neon-20 at the 5.63 Mev level at temperatures above 5×10^8 °K in supernova explosions is also given. (P.C.H.)

Cosmic Radiation

31461 (NP-10755) PROTECTION AGAINST SOLAR FLARE PROTONS. Trutz Foelsche (National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.). [Jan. 1961]. 41p.

Presented at the Seventh Annual Meeting of the American Astronautical Society, Dallas, Texas, January 16-18, 1961.

Mass shielding requirements are estimated for flight during extreme flare proton events in the distant environment of the earth. As examples for calculation of doses behind different amounts of shielding are chosen the high-energy event on February 23, 1956, the low-energy extreme-flux events from May 10 and July 1959, and the high-flux event of August 22, 1958. It is assumed that the primary particles are attenuated or come to rest by electronic collisions only, neglecting nuclear collisions for the high-energy event of February 1956. Using extrapolated, high-maximum fluxes and long duration of this maximum intensity, 25 g/cm^2 H_2O equivalent shielding would reduce the flare proton doses to 25 to 50 rep. The maximum weight of a cylindrical shelter of H_2O equivalent material having an inner diameter of 1 m and a height of 2 m would be 4500 to 5000 pounds. Data on the November 12 and 15, 1960 medium-energy flare events indicate about double maximum intensity and a flatter proton spectrum in these events, than observed in the extreme flux events of 1959. Estimated dose values as function of shielding thicknesses do not surpass the upper limits given before. A calculation of the contribution of secondaries resulting from nuclear reactions to the dose rate behind the visualized amounts of low Z-number shielding material for the prompt spectrum of the high-energy event February 1956 shows no substantial enhancement of the physical dose rate in rep/hr in comparison to that obtained in the first approach. The

necessary shielding weights inferred from those estimated constitute a substantial part of the weight of smaller vehicles visualized for excursions of extended duration, for which the possibllity of predicting the absence of such events appears limited. (auth)

31462 (NP-10763) ATMOSPHERIC PHENOMENA, ENERGETIC ELECTRONS, AND THE GEOMAGNETIC FIELD. J. R. Winckler (Minnesota. Univ., Minneapolis. School of Physics). July 1961. 51p. (CR-40)

A discussion is given of x-ray measurements associated with the dumping of electrons from the magnetic field, made with balloons and rockets. It is shown that in the normal auroral zone the x-ray bursts occur throughout the 24-hour period, have peak intensities corresponding to electron fluxes of 10^6 to $10^7/cm^2 \cdot sec$, and have integrated fluxes over a 24-hour period of $10^{10}/cm^2$. In the auroral zone the x-ray bursts arising from 30-kv or higher electrons are not correlated with visible aurorae. Direct rocket measurements of bright aurorae in the auroral zone confirm this by showing the absence of appreciable electron fluxes above 20 kv. At lower latitudes the x rays are well-correlated with visible aurorae, have peak burst intensities of 10^9 electrons/$cm^2 \cdot sec$ greater than 30 kv, and are strongly correlated with negative bays in the local magnetic field. The Van Allen outer radiation belt electrons provide a suitable reservoir for explaining many characteristics of the x rays because of the latitude distribution and energy of the trapped radiation. Acceleration, deceleration, and redistribution processes are suggested which may result in the precipitation of these electrons to form the x rays. (auth)

31463 NEW FORMULA FOR DETERMINING LORENTZ FACTOR γc FOR MESON SHOWERS. Maria Sahini (Inst. of Nuclear Physics, Bucharest). Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz. Studdi cercetări fiz., 12: No. 1, 61-6(1961). (In Rumanian)

A new formula was derived for evaluating the Lorentz factor for meson showers, assuming the C system is isotropic; $m = \beta_c/\beta' > 1$, (where β_c is the rate of the C system in relation to the L system and β' the rate of particle formation in the C system); $\beta'_{\theta\,1/2} = \beta'_{\theta\,lim}$ (where $\beta'_{\theta\,1/2}$ and $\beta'_{\theta\,lim}$ are the rates of C-system particles appearing in the L system for median angle and for maximum possible angle). The derived formula $\gamma_c = \text{cotg}\,\theta_{1/2}[2(1 - \text{cotg}^2\,\theta_{lim}/\text{cotg}\,\theta_{1/2})^{1/2} - 1]^{1/2}$ was correlated with other methods of Lorentz factor evaluation. The method offers a more accurate formula for γ_c at $m > 1$ and evaluates the fraction of inverse by emitted particles in the C system that appear in the L system. The method can be applied to showers with two centers. (tr-auth)

31464 NEUTRON DECAY AS IONIZATION FACTOR IN UPPER ATMOSPHERE. V. N. Kessenikh (Tomsk State Univ., USSR). Izvest. Vysshikh Ucheb. Zavedeniĭ, Fiz., No. 2, 176(1961). (In Russian)

Published data on radiation belts produced by neutrons leaking out of the atmosphere into the ionosphere are analyzed. (R.V.J.)

31465 DYNAMICS AND STRUCTURES OF THE OUTER RADIATION BELT. C. Y. Fan, P. Meyer, and J. A. Simpson (Univ. of Chicago). J. Geophys. Research, 66: 2607-40 (Sept. 1961).

From an analysis of electron measurements in the Explorer VI satellite (August 7-October 6, 1959) four time-dependent parameters which characterize the outer electron belt were investigated. They are the equatorial electron intensity I_0, the equatorial range from the earth R_0 of the peak intensity, the electron-density distribution along a line of force through the intensity peak, and a measure of the change in electron spectrum with time. These parameters, along with measurements of magnetic field intensity, make it possible to study the origin of the changes in electron intensity and distribution which are known to occur in the outer belt. Magnetic storms occurred during the observation on Explorer VI. Within the sequence of changes in the outer belt induced by these geomagnetic storms, there are changes of the parameters which are accounted for only by invoking an irreversible energy gain or loss within the outer belt. The energy gain process appears to be through irreversible local acceleration of electrons. The energy loss process leads to a stable mirror-point distribution characteristic of the periods between geomagnetic storms. The time intervals within which each of these processes is operative are identified. Reversible processes are possibly the cause for other changes. The foregoing analysis rests upon the proof given that the outer-belt peak intensity coincides over a wide range of geomagnetic latitudes with magnetic field lines of force in the centered dipole approximation. Consequently, the measured electron-intensity maximum is used as a 'tracer' of the geomagnetic field lines of force for analyzing changes in the outer belt with time. It is shown that even during geomagnetic storms the trace of the electron-intensity maximum followed a centered dipole line of force. This indicates that at all times the particle-energy density of the radiation belt is much less than the energy density of the magnetic field in the region. The electron fluxes, high-energy proton fluxes, and possible electron spectra are investigated. Two distinct peaks of electron intensity are identified to persist in the outer belt for about 2 months, and it is shown that these peak distributions undergo radial motion during geomagnetic disturbances. (auth)

31466 FORBUSH DECREASE OF THE FLUX OF HEAVY PRIMARY NUCLEI OF COSMIC RAYS ON MAY 12 AND JULY 12, 1959. S. Biswas (Univ. of Minnesota, Minneapolis). J. Geophys. Research, 66: 2653-7(Sept. 1961).

The time variation of the flux of heavy nuclei with $Z \geq 3$ of primary cosmic radiation was measured during seven balloon flights on May 6 to 12, 1959, and on July 10 to 12, 1959. Six of these flights were made from Minneapolis and one from Churchill, Canada. During a quiet day on May 6, 1959, the flux of these nuclei at the top of the atmosphere was 21.2 ± 2.3 particles/$m^2 \cdot sec \cdot sr$. After the Forbush decrease on May 12, 1959, the value was 10.0 ± 1.4 particles/$m^2 \cdot sec \cdot sr$, showing a reduction of 53 ± 9% of the primary heavy nuclei flux. On July 10 and 11, the flux of $Z \geq 3$ nuclei at the top of the atmosphere was measured as 17.5 ± 1.7 particles/$m^2 \cdot sec \cdot sr$ before the Forbush decrease and 10.0 ± 1.8 particles/$m^2 \cdot sec \cdot sr$ after the Forbush decrease on July 12. The reduction was 43 ± 9% during this event. The Deep River neutron monitor showed a reduction of counting rates of 12 and 7.5% respectively during these two Forbush decrease events. (auth)

31467 RADIOACTIVITY PRODUCED IN DISCOVERER XVII BY NOVEMBER 12, 1960, SOLAR PROTONS. John T. Wasson (Air Force Cambridge Research Labs., Bedford, Mass.). J. Geophys. Research, 66: 2659-63(Sept. 1961).

Scintillation-spectroscopy measurements on a AgBr emulsion block from Discoverer XVII, which was flown during a period of high solar cosmic-ray activity on November 12, 1960, reveal a gamma spectrum attributable to 8.4-day Ag^{106}. The disintegration rate, corrected to a probable production time of 2200 UT, November 12, 1960, is

14 dis sec^{-1}. If one assumes a (p,pn) cross section of 100 mb, and applies the thin-target formula for production of radioactivity, this corresponds to a total proton dosage of about 1.6×10^8 protons cm^{-2} within the emulsion, and to a value of 16 rads radiation dosage. An attempt to measure the gamma spectrum of 40-day Ag^{105} was unsuccessful, allowing the assignment of an upper limit on the disintegration rate of 1 dis sec^{-1} at the time of production. A search for 1.3-year Cd^{109} was unsuccessful. (auth)

31468 THE LUNAR NEUTRON FLUX. R. E. Lingenfelter, E. H. Canfield, and W. N. Hess (Univ. of California, Livermore). J. Geophys. Research, 66: 2665-71(Sept. 1961). (UCRL-6289)

The equilibrium neutron-leakage spectrum at the lunar surface and the neutron capture as a function of depth beneath the surface were calculated for a number of assumed lunar surface compositions. The leakage spectrum is found to be particularly sensitive to hydrogen abundance; an experiment is accordingly proposed to determine the hydrogen content of the lunar surface by neutron flux measurements near the moon. (auth)

31469 TRANSRESONANT ELECTRON ACCELERATION. E. N. Parker (Univ. of Chicago). J. Geophys. Research, 66: 2673-6(Sept. 1961).

Helliwell and Bell have suggested synchronous acceleration of electrons by electromagnetic waves in the whistler range in the geomagnetic field. The acceleration of trapped electrons by electromagnetic waves is here generalized to include nonsynchronous or transresonant acceleration. It is shown that whistlers will scatter the electron velocity, by an amount inversely proportional to the square root of the time rate of change of the whistler frequency, during the time that the whistler frequency is passing over the electron gyrofrequency. Only electrons with initial energy above about 10^2 ev can see the Doppler-shifted whistler frequency at the gyrofrequency and be affected by this transresonant acceleration. Thermal electrons experience no effect. Current observation of whistlers in the outer geomagnetic field is too sketchy to allow a determination of transresonant acceleration rates, so that the relative importance, as compared, for example, with the strong-whistler synchronous acceleration of Helliwell and Bell, cannot be assessed. The importance of whistler acceleration can be established when the whistler frequency spectrum and recurrence rate are known throughout the geomagnetic field. (auth)

31470 EFFECT OF ELECTRON-ION COLLISIONS IN THE F REGION OF THE IONOSPHERE ON THE ABSORPTION OF COSMIC RADIO NOISE AT 25 Mc/s AT AHMEDABAD. CHANGES IN ABSORPTION ASSOCIATED WITH MAGNETIC STORMS. K. R. Ramanathan, R. V. Bhonsle, and S. S. Degaonkar (Physical Research Lab., Ahmedabad, India). J. Geophys. Research, 66: 2763-71(Sept. 1961).

Measurements of cosmic radio noise at 25 Mc/s showed much larger values of absorption than those observed by Shain and Mitra in Australia. This fact, together with the empirically known dependence of the absorption of the critical frequency of the F region, and the effect of magnetic storms on the absorption found from the Ahmedabad observations led to the examination of the different possible parameters that may affect cosmic-noise absorption. It is found that electron-ion collisions in the F region both below and above the level of maximum electron density contribute in a substantial way to the absorption of cosmic radio noise. The values of hourly absorption due to collisions of electrons with neutral particles and with ions were calculated for a period of 6 days in August-September 1957, when there were three magnetic storms. The results obtained show a depletion of electrons above F maximum on the day following the commencement of the magnetic storm and a refilling on later days. The results are discussed in relation to findings from satellite observations about particle fluxes in the Van Allen belts during magnetic storms. (auth)

31471 A MODEL OF SOLAR-FLARE-INDUCED IONIZATION IN THE D REGION. R. C. Whitten and I. G. Poppoff (Stanford Research Inst., Menlo Park, Calif.). J. Geophys. Research, 66: 2779-86(Sept. 1961).

With data from the Naval Research Laboratory Sunflare II rocket observation of a class 2^+ solar flare that occurred on August 31, 1959, and the 18-Mc cosmic noise intensity record obtained during the flare, a model of flare-induced ionization in the D region was constructed, and a value for the dissociative recombination coefficient obtained. An experiment to determine the validity of the model and to obtain more precise values of the recombination coefficients is suggested. (auth)

31472 RADIATION MEASUREMENTS IN THE SLOT BETWEEN THE VAN ALLEN BELTS TO AN ALTITUDE OF 1415 KILOMETERS. G. A. Gurtler (NASA Langley Research Center, Langley Field, Va.). J. Geophys. Research, 66: 3050-4(Sept. 1961).

Satellite experiments on the radiation belts surrounding the earth indicate that the flux of high-energy particles decreases substantially in the slot between the inner and outer Van Allen belts. A radiation measuring instrument, consisting of an Auton-type 114/6993 Geiger-Muller tube and a circuit chassis, was placed in the payload of the Scout ST-1, which was fired July 1, 1960. The sensing system was calibrated by a Co^{60} source, and a pulse generator was substituted for the Geiger tube to obtain response to particle counts. Data were recorded from launch until the telemeter signal was lost 1326 seconds before splash. These data are represented graphically. (L.N.N.)

31473 THE TOTAL ELECTRON CONTENT THROUGH THE ENTIRE IONOSPHERE BY THE FARADAY ROTATION TECHNIQUE. O. Burkard (Univ. of Graz). J. Geophys. Research, 66: 3058-9(Sept. 1961).

Change of electron content versus $(\cos \chi)^{1/4}$ is plotted, where χ is the zenith angle of the ionizing solar radiation. The result is a straight line. Absolute values for the electron content n_0 are thus obtained by shifting this straight line vertically in such a way that for $\cos \chi = 0$, $n_0 = 0$. It is found that N_a / N_b is larger at night than at noon. Using this information, the possibility of determining the variations of the ionizing solar radiation arises. (L.N.N.)

31474 FLARES ASSOCIATED WITH THE 1960 NOVEMBER EVENT AND THE FLARE NIMBUS PHENOMENON. M. A. Ellison, Susan M. P. McKenna, and John H. Reid (Dublin Inst. for Advanced Studies). Monthly Notices Roy. Astron. Soc., 122: 491-501(1961).

Outstanding flares occurred on November 10, 12, 15, and 20, 1960, in association with an active region and complex spot group which had its central meridian passage on November 12. The last three of these flares projected into space showers of cosmic rays which were registered on the earth by neutron monitors at ground level within 30 minutes after the flare flash, bringing up to ten the number of these events so recorded since February 28, 1942. Geomagnetic storms of unusual intensity also occurred on November 12 and 13, and again on November 15. The flares of November 10 and 12 were photographed under excellent conditions on films taken at 1-minute intervals with the Lyot Hα heliograph. These results are analyzed and flare

light-curves are plotted. A new phenomenon—the flare nimbus—was found in association with some Class 3 and 3 + flares recorded with the heliograph. This is a dark absorbing halo which begins to surround the flare some few minutes after the filaments have reached their maximum light intensity: its duration is >1-2 hours and its diameter is about 300,000 km. The characteristic properties of the nimbus are described for the five observed cases—July 16, 1959, April 1, June 1, November 10 and 12, 1960—and possible causes are discussed. There is a strong presumption that the phenomenon is the optical counterpart of the cloud of relativistic electrons whose occurrence in the flare region was postulated in order to account for the radio emission continuum of Type IV. (auth)

31475 THE PRODUCTION AND PROPERTIES OF MESONS AT HIGH ENERGIES. F. A. Brisbout, C. Gauld, J. Lehane, C. B. A. McCusker, J. Malos, K. Nishikawa, and L. G. Van Loon (Univ. of Sydney). Nuclear Phys., 26: 634-48(1961). (In English)

Results from a 10-l stack of Ilford K5 emulsion flown to 38.4 km are presented. It is shown that the transverse momentum spectrum of the secondary particles of jets has two peaks at about 0.4 and 2.0 Bev/c respectively, and possibly a third peak at about 8 Bev/c; that the interaction cross section of secondary pions is considerably smaller than the geometric value; that the interactions they produce in emulsions have a lower average multiplicity than proton produced interactions in the same energy range; and that the number of particles per interaction close to the forward direction is less than that expected from extrapolation from slightly greater angles. The results are compared with those of other experiments and their meaning discussed. (auth)

31476 ON THE TWO-CENTRE MODELS OF PARTICLE EMISSION IN COSMIC RAY JETS. J. (Ya.) Pernegr, V. Šimák, and M. Votruba (Inst. of Physics, Czechoslovak Academy of Sciences, Prague). Nuovo cimento (10), 21: 555-8(Aug. 1, 1961). (In English)

Two two-center models, the "fireball" and "isobar" models, are compared for $n_s \geq 6$ and $N_h \leq 2$. The inelasticity calculated using these models is compared with the observed inelasticity. It is found that the fireball model is the more accurate model at primary energies above 1000 Bev, and the isobar model is the more accurate model below this energy. (T.F.H.)

31477 THE STUDY OF HIGH-ENERGY γ-RAYS PRODUCED BY COSMIC RADIATION AT 40,000 FEET. PART I. EXPERIMENTAL DISPOSITION, AND DETERMINATION OF ENERGY AND NATURE OF ELECTROMAGNETIC CASCADES. J. G. Duthie, C. M. Fisher, P. H. Fowler, A. Kaddoura, D. H. Perkins, and K. Pinkau (Univ. of Bristol, Eng.). Phil. Mag. (8), 6: 89-111(Jan. 1961).

Two composite stacks of alternate sheets of nuclear emulsion were used to investigate electromagnetic cascades in the cosmic radiation. The stacks were exposed in BOAC Comet aircraft for a total of 1400 hours at about 38,000 ft. Approximately 600 cascades were observed, and a sample of these was classified as arising either from γ rays incident from the atmosphere or as a result of nuclear interactions in the stack. The zenith-angle distribution of the cascades was used to determine the attenuation length of the radiation producing the cascades. The number of electron tracks in the cascades was determined by a photometric method and the relation between the photometric density and the cascade energy was established for the two types of cascade. (auth)

31478 THE STUDY OF HIGH-ENERGY γ-RAYS PRODUCED BY COSMIC RADIATION AT 40,000 FEET. PART II. THE ENERGY SPECTRUM OF CASCADES AND ITS INTERPRETATION. J. G. Duthie, C. M. Fisher, P. H. Fowler, A. Kaddoura, D. H. Perkins, K. Pinkau, and W. Wolter (Univ. of Bristol, Eng.). Phil. Mag. (8), 6: 113-31(Jan. 1961).

The results of the measurement of the density of electromagnetic cascades described previously are discussed. For events initiated by single γ rays from the atmosphere it was found that the integral spectrum of cascade energy may be represented by a power law with exponent -3.0 ± 0.20 for the range 1200 to 8000 Bev. The corresponding exponent for cascades associated with local nuclear interactions is -2.9 ± 0.2 in the same energy range. The γ spectrum was used to calculate the pion spectrum in the atmosphere. This was compared with that deduced from measurements on μ-mesons at sea level or underground. Reasons for the resulting discrepancies are discussed. The flux of cascades associated with local nuclear events when compared with the nuclear flux deduced from measurements on extensive air showers yielded values for the fractional energy, K_π, radiation as pions in collisions of nucleons in the energy range 10,000 to 100,000 Bev. It was found that K_π decreases strongly with increasing primary energy. An upper limit to K_π was also deduced from observations on the longitudinal development of these cascades. (auth)

31479 THE ALPHA-PARTICLE COMPONENT OF THE PRIMARY COSMIC RADIATION OVER NORTHERN ENGLAND. G. R. Stevenson and C. J. Waddington (Univ. of Bristol, Eng.). Phil. Mag. (8), 6: 517-30(Apr. 1961).

Alpha particles of the primary cosmic radiation were studied in a stack of nuclear emulsions exposed over northern England on July 29, 1959. A flux of 167 ± 12 α particles/m^2 ster sec was found. The energy spectrum was examined between the cut-off energy of about 250 Mev per nucleon and an energy of 1.5 Bev per nucleon. It was not found to be significantly different from that observed during solar maximum. The energy spectrum was also examined as a function of zenith angle. An apparently significant linear relationship was established between neutron monitor counts recorded at sea level and primary α-particle flux values. A value of 24.0 ± 2.4 cm was determined for the mean free path of α-particles in nuclear emulsions, which is somewhat higher than previously reported values. (auth)

31480 THE SOLAR DIURNAL VARIATION OF COSMIC RAYS DURING 1958 AND 1959, AT MAKERERE, HERMANUS AND HERSTOMONCEUX. D. M. Thomson (Makerere Coll., Kampala, Uganda, [East Africa]). Phil. Mag. (8), 6: 573-86(Apr. 1961).

The results of observations of the solar diurnal variation in cosmic radiation at Makerere (East Africa), Hermanus (South Africa), and Herstomonceux (England) are presented for the years 1958 and 1959. The average amplitude and phase of the 24 hr component of the variation were obtained at each station and the relative values were compared with the values predicted by two types of modulation of the primary spectrum. In the first case a modulation of the type $\Delta n(P)/n(P) = a \cdot P^{-1}$ was considered where P is the magnetic rigidity of the primary particle: The best account of the main features of the observations was given if the modulation was effective for rigidities in excess of a cut-off value which averaged 15 gv, the value of a being 0.236, and if the direction of maximum modulation was 79°, to the east of the sun-earth line. In the second case the

primary spectrum was considered to be modulated in the manner suggested on theoretical grounds by Elliot (1960). Neither model gave complete agreement with observation. (auth)

31481 SOLAR FLARE TRITIUM IN A RECOVERED SATELLITE. E. L. Fireman, J. DeFelice, and D. Tilles (Smithsonian Astrophysical Observatory, Cambridge, Mass.). Phys. Rev., 123: 1935-6(Sept. 15, 1961).

Tritium and argon-37 were measured in samples of the Discoverer XVII satellite. The tritium content was unusually high, the maximum value being 163 ± 2 tritium decays/kg min. The ratio of tritium to argon-37 atoms was 2500 ± 300 in an iron sample and larger than 9000 in a lead sample. The tritium activity decreased rapidly with depth. The tritium content is too large by a factor of more than one hundred to be explained by nuclear interactions induced by incident protons or alpha particles. The tritium must result from a flux of incident tritons stopped in the material. (auth)

31482 RADIATION EFFECTS AT A HIGH ALTITUDE. L. V. Kurnosova, V. I. Logachev, L. A. Razorenov, and M. I. Fradhkin (Lebedev Inst. of Physics, Moscow). Priroda, 50: No. 4, 85-7(Apr. 1961). (In Russian)

A region of abnormally intense charged particle flux was recorded on Aug. 19, 1960, by a counter in a satellite at 300 km elevation over the southern part of the Atlantic Ocean between Africa and South America at 25 to 50° South latitude and 0 to 50° West longitude (the maximum count was 100 times that in regions outside the anomaly). In addition to the South Atlantic anomaly, on Aug. 20, 1961, Northern and Southern anomalies were located. (R.V.J.)

31483 CHANGES IN THE ELECTRON DENSITY DISTRIBUTION IN THE IONOSPHERE OVER AHMEDABAD ASSOCIATED WITH SOLAR FLARES AND MAGNETIC STORMS. PART I. JULY 10–19, 1959. S. S. Degaonkar (Physical Research Lab., Ahmedabad, India). Proc. Indian Acad. Sci., Sec. A, 54: 24-35(July 1961). (In English)

Data are presented on electron density distribution in the ionosphere over Ahmedabad during a highly disturbed period in July 1959. The true heights of reflection of the various frequencies are calculated from vertical soundings made using the tables of Schmerling and Ventrice and modifying them for the magnetic latitude of Ahmedabad (Dip 34°). The following information is presented along with the calculation made for the height profiles: charts of equal electron density at intervals of 2×10^5 electrons/cc and a table of the hourly values of maximum electron density and total electron content for the period July 10 to 19, 1959. (N.W.R.)

31484 THE ELECTRON CONTENT OF THE IONOSPHERE IN WINTER. J. V. Evans and G. N. Taylor (Univ. of Manchester, Eng.). Proc. Roy. Soc. (London), A, 263: 189-211(Sept. 5, 1961).

Observations at two closely spaced frequencies of the Faraday rotation of moon-reflected radio waves are described. These measurements provided accurate values for the total electron content of the ionosphere for many hours on successive days. The observations reported span a period of one month during the winter of 1960. Short-period fluctuations of the total electron content were observed. These were of about 2 to 3% in amplitude and occurred chiefly during the day-time. The gross shape of the F2 region as determined by the ratio of the number of electrons above the F2 peak to the number below was roughly constant during the day, but showed a wide scatter of values at night. The scale height of the ionizable constituent at the F2 peak was found to be about the same as that of the neutral particles during the day, indicating almost complete mixing. At night, the scale height of the ionizable constituent appeared to increase with the planetary magnetic index K_p. It is not possible to say if this was the result of heating of the region or the consequence of electrodynamic drifts. (auth)

31485 THE PRODUCTION RATE OF NATURAL TRITIUM. Harmon Craig and Devendra Lal (Univ. of Calif., La Jolla). Tellus, 13: 85-105(Feb. 1961). (In English)

A detailed evaluation is made of the production rate of natural tritium in the pre-thermonuclear epoch. Deuterium and tritium analyses on the same precipitation samples are used to establish the uncontaminated tritium levels in precipitation sampled before the Castle tests, and the tritium balance is calculated for the North American troposphere. The global mean production rate $\overline{Q}$, calculated from the geochemical inventory, is found to be 0.5 ± 0.3 atoms T/cm^2 sec. This value is three to four times smaller than values found previously by such calculations because of the following developments: The deuterium and tritium data show that the increases in tritium content observed during early thermonuclear tests before Castle are due to addition of synthetic tritium rather than to random fluctuations. The deuterium-tritium relationships are used to establish the general pattern of tritium variations over the North American continent and to evaluate the uncontaminated tritium levels. The mean stratospheric residence time for tritium is found to be about 1.6 years from studies on fission product fall-out and from the latitudinal variation of stratospheric cosmic ray production. Stratospheric tritium is preferentially injected into the troposphere at high latitudes, as shown by fallout observations. The tritium influx into the North American troposphere is therefore higher than the mean global value. The predicted production rate is calculated from cosmic ray and nuclear cross section data using the star production rates in the atmosphere. The predicted mean global tritium production rate during an average solar cycle is found to be 0.25 ± 0.08 atoms T/cm^2 sec. The variation in the production rate over an average solar cycle is found to be ±4.5%. Within the uncertainties of the data and calculations, the production rates calculated from the geochemical inventory and from the cosmic ray data are in agreement, and there is thus no observational evidence for accretion of tritium from an extra-terrestrial source. (auth)

31486 STANDARD ERRORS AT HARMONIC ANALYSIS ON COSMIC RAY DATA. Eric Dyring and Bengt Rosen (Univ. of Uppsala). Tellus, 13: 113-18(Feb. 1961). (In English)

Standard errors of harmonic analysis were calculated by three different methods. These methods are discussed and numerical calculations were carried out from the results of harmonic analyses made on data from the neutron monitors in Uppsala and Murchison Bay. Periods covering from single days up to the mean of three years were used for the comparison between the results. Although the standard error calculated according to the three methods include different types of variations, the results show good similarity. One of the methods also gives indications that only in some cases the addition of a second harmonic will be an improvement of the fit. (auth)

31487 MOSAIC METHOD OF PROGRAM COMPOSITION FOR ELECTRON-PHOTON CASCADE CALCULATION BY MONTE CARLO METHOD WITH ELECTRONIC COMPUTERS. V. V. Chavchanidze, R. S. Shaduri, and

V. A. Kumsishvili. Trudy Inst. Fiz., Akad. Nauk Gruzin. S.S.R., 6: 69-95(1958). (In Russian)

A programming scheme is given for calculating electron-photon cascades by Monte Carlo methods. The programming method is based on the synthesis of a general program from basic subprograms which realize the calculation of different physical phenomena of the cascade. The order of subprograms is regulated by a certain rule. Before the beginning of a new cascade calculation the previous cascade is calculated completely. The proposed method can be modified for calculating different problems solved by Monte Carlo method. (auth)

31488 LATERAL DISTRIBUTION OF THE PENETRATING COMPONENT IN EXTENSIVE AIR SHOWERS. M. F. Bibilashvili. Trudy Inst. Fiz., Akad. Nauk Gruzin. S.S.R., 6: 141-64(1958). (In Russian)

The lateral distribution of the penetrating component of extensive air showers with total particles between 10^5 and 5×10^5 was studied at 400 m above sea level, in a tunnel at 65.5 mwe underground. The investigation was performed at distances of 0, 10, 20, 30, 45, and 60 m from the shower axis. The lateral distribution can be described by the function: $\rho(R) = (0.66 \pm 0.09) \exp [-(0.00058 \pm 0.00009) r^2]$. The total number of penetrating particles and the energy of the penetrating component at sea level are found. (auth)

Criticality Studies

31489 (ANL-6401) CRITICAL STUDIES OF DILUTE CARBIDE FAST REACTOR CORE. ZPR-III Assembly 34. R. J. Hubert, J. K. Long, R. L. McVean, and J. M. Gasidlo (Argonne National Lab., Idaho Falls, Idaho). May 1961. Contract W-31-109-eng-38. 21p.

Critical studies were made with a simulated, large, dilute power reactor having uranium carbide as fuel. The uranium in the core was 30.7% enriched, and the atomic ratio of uranium to carbon was 0.946. The critical mass was 503.01 kg U^{235} and the critical volume 574.47 liters. Central reactivity coefficients, effective fission cross-section ratios, heterogeneity effects, reactivity worth of distributed materials, foil irradiations, and the average prompt neutron lifetime were measured. Multigroup calculations using the Yiftah, Okrent, and Moldauer cross-section set overestimated k for the critical configuration by 4.7%. (auth)

31490 (CEND-137) A SURVEY OF THE BEGINNING OF LIFE CHARACTERISTICS OF URANIUM-FUELED, WATER-MODERATED LATTICES. J. Bengston and R. L. Hellens (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). July 1961. Contract AT(30-1)-2379. [Contract Title]: STUDY OF SLIGHTLY-ENRICHED URANIUM-WATER LATTICES WITH HIGH CONVERSION RATIO. 51p.

Calculations were performed on the beginning of life characteristics of uranium-fueled water-moderated lattices with water-to-uranium volume ratios of 0.4 to 4.0 and enrichments of 1 to 4%. Both uranium metal and UO_2 fuel were investigated. Results indicated that an initial conversion ratio of the order of 0.9 may be attainable in low-enrichment uranium-fueled, water-moderated reactors with sufficient initial excess reactivity to allow a reasonable lifetime. The maximum conversion ratio for a given initial excess reactivity corresponded to fairly dry cores, with metal-to-water volume ratios of the order of one. (M.C.G.)

31491 20% ENRICHED UO_2-GRAPHITE FUEL DISKS FOR SEMI-HOMOGENEOUS CRITICAL ASSEMBLY. R. Ueda (Japan Atomic Energy Research Inst., Tokyo). E. Sugimoto, K. Watanabe, and T. Ogura. Atompraxis, 7: 337-43(Sept. 1961). (In English)

About 25500 fuel disks of 20% enriched UO_2–graphite for the Semi-Homogeneous Experimental Facility in JAERI were fabricated. In preparing these disks, satisfactory quality controlling with respect to homogeneity and accuracy was carried out. Special care was also taken to prevent the generation of radioactive dust, which resulted in success from the viewpoint of accountability and safety. These fuel disks were charged into the critical assembly at JAERI, and criticality was successfully attained with little deviation from the calculated value. (auth)

31492 ON THE THEORY OF "SPIKING" IN NEUTRON MULTIPLYING SYSTEMS. S. E. Corno (AGIP Nucleare, Milan). Nuovo cimento (10), 21: 484-99(Aug. 1, 1961). (In English)

A theory is developed for neutron multiplying structures in which a small number of highly reactive blocks (spikes) are imbedded in a finite subcritical medium. This basic medium is assumed to be homogeneous from the standpoint of neutron migration and multiplication. The theory may be derived by performing a proper inversion of the integral operator describing the thermal flux distribution. The problem is placed in the same form encountered when treating, along the lines of heterogeneous theory, a "reactor with a small number of blocks." Cylindrical multiplying structures are examined: the resulting treatment—within the limits of the age-diffusion or multigroup theory—can be considered as the exact one, at least for those systems in which the spikes can be taken as line singularities of the neutron field. Spiked structures, even if the basic multiplying medium is left unchanged, possess as many degrees of freedom as the number of classes of spikes constituting the system, times the number of parameters characterizing each spike. An optimization theory is found for such types of nuclear reactors in order to fulfill, by a proper choice of the free parameters, the criticality condition and other requirements. (auth)

Elementary Particles and Radiations

31493 (CEA-1969) ETUDE DU RAYONNEMENT DE FREINAGE. PRODUCTION DE RAYONS γ PAR DES ACCELERATEURS D'ELECTRONS. (Study of Bremsstrahlung. Production of γ Rays by Electron Accelerators). Jean Bernard (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1961. 108p.

Various theories of bremsstrahlung radiation are critically compared. Experimental data on the production of γ radiation by relativistic electron beams are compared to the theoretical results, in order to estimate the validity of the various theories. (auth)

31494 (CTSL-28) GAUGE THEORIES OF VECTOR PARTICLES. Sheldon L. Glashow and Murray Gell-Mann (California Inst. of Tech., Pasadena. Synchrotron Lab.). Apr. 24, 1961. Contract [AT(11-1)-68]. 49p.

The possibility of generalizing the Yang-Mills trick is examined. Theories of vector bosons which are invariant under continuous groups of coordinate-dependent linear transformations are discussed. All such theories may be

expressed as superpositions of certain "simple" theories, and each "simple" theory is shown to be associated with a simple Lie algebra. Mass terms can be introduced for the vector bosons if the gauge-invariance for coordinate-dependent gauge functions is destroyed. The theories corresponding to three particular simple Lie algebras are examined in some detail as examples. One of them might play a role in strong interactions if there is a broken super-symmetry. The intermediate vector boson theory of weak interactions is discussed. The "schizon" model cannot be made to conform to the requirements of partial gauge-invariance. It is possible, however, to find a formal theory of four intermediate bosons that are partially gauge-invariant which gives an approximate $|\Delta I| = \frac{1}{2}$ rule. (D.L.C.)

31495 (JINR-D-741) ON $\bar{K} + N \rightarrow \Lambda(\Sigma) + \gamma$ PROCESSES. L. I. Lapidus and Kuang-chao Chou (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems and Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 11p.

It is shown that information on the $\Lambda(\Sigma) + \pi \rightarrow \Lambda(\Sigma) + \gamma$ processes may be obtained by investigating the reactions $K + N \rightarrow \Lambda(\Sigma) + \gamma$. A detailed phenomenological analysis of these processes in the S-state is made. The Kroll-Ruderman theorem is considered for the pion photoproduction on hyperons near the threshold. (auth)

31496 (JINR-D-757) THE PION-PION SCATTERING AT LOW ENERGY. A. V. Efremov, D. V. Shirkov, and H. Y. Tzu (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 26p.

The integral equation for $\pi-\pi$ scattering at low energy was investigated by the analytical method. It is shown that the scattering lengths of the s-waves are positive. The solutions can have three different possible asymptotic behaviors at high energy $(1/\ln q^2)$, $(1/q^2)$ and $(1/q^4)$. The solutions with the asymptotic behavior $(1/q^2)$ or $(1/q^4)$ have narrow resonance in the p-wave, which is not connected with the existence of any heavy unstable particle. The possible connection between the narrow resonances observed in various processes and the existence of the effective non-renormalizable interactions is pointed out. Further support is given to the view, that the dispersion relation together with the unitarity condition does not lead to a unique dynamical theory. An explicit approximate adiabatic solution with the logarithmic asymptotic behavior was obtained in the limit of small interaction constant. Comparison with the result of the perturbation calculation yielded good agreement in the region of low energy, which in turn justified the approximation used in the derivation of the integral equation. (auth)

31497 (JINR-D-763) IS "MUONIUM ONE" HEAVIER THAN "MUONIUM TWO" OR VICE VERSA? L. B. Okun and B. Pontecorvo (Pontekorvo). (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1961. 5p.

A discussion is given of the transformations of muonium, $M \equiv (\mu^+ e^-)$, into antimuonium, $\bar{M} \equiv (\mu^- e^+)$, for which the oscillations $M \rightleftharpoons \bar{M}$ are analogous to the $K^0 \rightleftharpoons \bar{K}^0$ transformations. Considerations are given for: the case when there is only one type of neutrino, and there is no direct (μe) interaction; the case where the spin is 1; and the case where there are two types of neutrinos, ν_e and ν_μ. The possibility is discussed of the existence of multiplicative quantum numbers for which the transitions $M \rightleftharpoons \bar{M}$ are caused by a direct (μe) (μe) interaction, and there is no difference in the decay modes for M_1 and M_2. (B.O.G.)

31498 (JINR-P-748) NEKOTORYE ZAMECHANIYA O NEUPRUGOM VZAIMODEISTVII NUKLONOV. (Some Remarks on Nucleon Inelastic Interactions). M. S. Khvastunov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1961. 5p.

The hypothesis on isotopic invariance is applied in an analysis of inelastic nucleon-nucleon interactions in order to derive relations between cross sections of various reactions. It is assumed that an isotopically nonpolarized beam falls on an isotopically nonpolarized nucleon target. An analysis is made of the combination of all possible inelastic nucleon-nucleon interactions accompanying π meson production. (R.V.J.)

31499 (JINR-P-750) NEITRAL'NYE BARIONNYE TOKI I ODINOCHNOE ROZHDENIE GIPERONOV. (Neutral Baryon Currents and Production of Single Hyperons). M. A. Markov and Wang-hui Huang (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 3p.

Weak interactions between baryons, $n + n \rightarrow n + \lambda$ and $p + p \rightarrow p + \Sigma$, are analyzed in order to determine the existence of neutral baryons. The thresholds of the reactions are 256 and 537 Mev, respectively, while the thresholds of the respective reactions with pair production, $N + N \rightarrow N + \lambda + K$ and $N + N \rightarrow N + \Sigma E$, are 1.55 and 1.77 Bev, respectively. (auth)

31500 (JINR-P-751) PROVERKA PC- I PCT-INVARIANTNOSTEI V PROTSESSAKH RASPADA. (OBZOR). (Verification of PC and PCT-Invariants in Decay Process. (Review)). M. I. Shirkov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 40p.

Experiments on parity non-conservation may be treated as an indication that the parity operator P is not a correct representation of the geometric operation of the spatial reflection. The combined inversion PC, allowed to keep the equality of the right and left in the empty space, was suggested as a new representation. If, as a result of the experimental check, it turns out that the combined parity is not conserved, then it will be necessary either to find a new representation of the spatial reflection, or to admit that the vacuum is left or right. As far as such a fundamental significance is ascribed to the operator PC, then the planning of the corresponding experiments must not make use of any particular theories of interactions. In particular, the PCT-theorem must not be used. Therefore, the investigation of PC cannot be replaced by that of T-invariance, and the experiments with antiparticles are necessary. Possible experiments on $\pi^\pm$, $\mu^\pm$, K-decays as well as hyperon and antihyperon decays are being discussed, i.e., all the processes where the parity is not conserved, except the β-decay. The available experimental data indicate that the lifetimes of particles and antiparticles and the weights of the corresponding decay channels are equal. A more refined experiment has been performed for a μ-decay. It turns out that all the experiments made may be considered as a check of the PCT-invariance. Therefore, the present situation on checking the PC-invariance admits the following two formulations: experiment and PC-invariance do not contradict; and the experiments made cannot refute the assertion that there is no PC-invariance. All that has been said may be repeated with respect to PCT also, if the PC-invariance is considered more fundamental. The experiments required for distinguishing the consequences of PC and PCT-invariances are discussed. (auth)

31501 (JINR-P-759) ASIMMETRIYA V UGLOVOM RASPREDELENII NEITRONOV, ISPUSKAEMYKHPRI

ZAKHVATE μ^--MESONOV V KAL' TSII. (Asymmetry in Angular Distribution of Neutrons Emitted in μ^-Meson Capture in Calcium). V. S. Evseev, V. I. Komarov, V. Z. Kush, V. S. Roganov, V. A. Chernogorova, and M. M. Shimachak (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1961. 27p.

The asymmetry in the angular distribution of neutrons emitted during nuclear capture of polarized μ^- mesons ($\mu^- + A \rightarrow A + n + \bar{\nu}$) was measured in order to analyze the non-conservation of parity in μ^- absorption by protons and to determine the constants of μ^- weak interactions with nucleons. (R.V.J.)

31502 (JINR-P-762) SVOISTVA RESHENIYA URAVNENIYA LOU DLYA ODNOI MODELI LOKAL'NOI TEORII POLYA. (Solution of Low Equation for a Model of Local Field Theory). B. M. Barbashov and G. V. Efimov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 14p.

The solution of the Low equation has been obtained and is being investigated for the scattering amplitude of scalar mesons on the fixed nucleon which may be in the two states different by their mass. The solution turns out to be correct only under a definite restriction on the coupling constant g_r. The comparison between the Low amplitude and the solution found on the basis of the Hamiltonian formalism is being made. It turns out that for the energies $\omega < 2\mu$ the contributions from the many-particle states to the scattering amplitude are not essential. (auth)

31503 (LAMS-2580) A CALCULATION OF THE BETA ENERGY ABSORBED BY TRITIATED GASES IN SPHERICAL VESSELS. Marvin M. Mueller (Los Alamos Scientific Lab., N. Mex.). May 22, 1961. Contract W-7405-Eng-36. 59p.

A calculation of tritium beta energy absorption in spherical bulbs filled with mixtures of tritium and other gases is carried out under the empirically substantiated assumption that the energy absorption per spherical shell surrounding a point tritium source is representable by a pure exponential function. Primary and successive backscattering at the wall of the vessel is taken into account by means of a very approximate calculation. The computed energy absorption function for hydrogen gas in a silvered bulb agrees within ±3% over a wide range of gas pressure with the one available set of spherical ionization chamber data. (auth)

31504 (NYO-9755) THE CANONICAL THEORY OF MOTION OF A CHARGED PARTICLE IN A SLOWLY VARYING ELECTROMAGNETIC FIELD. Tosiya Taniuti (New York Univ., New York. Inst. of Mathematical Sciences). June 15, 1961. Contract AT(30-1)-1480. 28p. (MF-16)

The canonical theory of motion of a charged particle in a slowly varying, static electromagnetic field is formulated. The hamiltonian is written down explicitly in terms of the coordinates of the gyration and the drift. The method of approach is analogous to that of the canonical formalism with subsidiary condition as used in theories of collective motion in many-body systems, such as the motion of the center of gravity. In the lowest order of the perturbation, it is shown that the hamiltonian for the drift motion averaged over the gyration phase is given by adding to the original hamiltonian a potential term equal to the product of the magnetic moment and the magnetic field strength. (D.L.C.)

31505 (RM-2820-PR) CLASSICAL ELECTRON THEORY FROM A MODERN STANDPOINT. Sidney Coleman (RAND Corp., Santa Monica, Calif.). Sept. 1961. Contract AF49(638)-700. 50p.

The classical theory of a charged point particle interacting with the electromagnetic field is developed from first principles. The formalism is constructed so as to reveal the underlying physics and to stress the similarity between the classical theory and the corresponding quantum theory. A number of traditionally troublesome points are discussed, including the electromagnetic self-energy, the relativistic radiation-reaction equation, the occurrence and removal of runnaway modes, the radiation from a uniformly accelerated charge, and the relation between Maxwell's electrodynamics and the action-at-a-distance theory of Wheeler and Feynman. (auth)

31506 (UCRL-9691) CHARGE-EXCHANGE SCATTERING OF POSITIVE K MESONS ON DEUTERONS (thesis). Wonyong Lee (California. Univ., Berkeley. Lawrence Radiation Lab.). May 19, 1961. Contract W-7405-eng-48. 58p.

The total cross sections for K^+-d charge exchange scattering ($K^- + d \rightarrow K^0 + p + p$) are measured at K^+ energies of 52 to 456 Mev. The reaction is studied by a phase-shift analysis. The T = 1 phase shift is assumed to be a pure S-wave. For the T = 0 phase shift, SP and SPD fits are made. The measured differential cross sections are expanded into the partial waves, using impulse and closure approximations. (T.F.H.)

31507 (NP-tr-766) RADIATION OF A CHARGE MOVING PARALLEL TO THE INTERFACE OF TWO MEDIA. G. M. Garibyan and O. S. Mergelyan. Translated from Izvest. Akad. Nauk Armyan. S.S.R., Ser. Fiz.-Mat. Nauk, 13: No. 2, 123-9(1960). 11p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 11941.

31508 A PHENOMENOLOGICAL MODEL FOR HYPERNUCLEAR BINDING ENERGIES. J. W. Olley (Univ. of Sydney). Australian J. Phys., 14: 313-17(June 1961).

The model in which the total Λ-N interaction is replaced by a potential well V(r) in which the Λ moves and in which the only effect of varying A is to vary the radius but not the depth of the well is considered. The binding energy of the Λ, B_Λ, is then given by the ground state energy of a particle in this well. It is found that the well in which $V(r) = -V_0$ for $r < R$ and $V(r) = V_0 \exp\{-(r-R)/0.7\}$ for $r > R$ gave the best fit and an accurate agreement with all B_Λ except in the case of $\Lambda - He^7$ interaction. (L.N.N.)

31509 ON SOME REPRESENTATION OF PERTURBATION EXPANSION OF SCATTERING AMPLITUDE. W. Garczyński (Univ. of Wrocław, Poland). Bull. acad. polon. sci., Sér. sci., math., astron. et phys., 9: 467-71 (1961). (In English)

The Feynman diagram representation of perturbation expansion of scattering amplitude is derived. (L.N.N.)

31510 SOME TOPOLOGICAL PROPERTIES OF FEYNMAN DIAGRAMS. W. Garczyński (Univ. of Wrocław, Poland). Bull. acad. polon. sci., Sér. sci., math., astron. et phys., 9: 473-6(1961). (In English)

Mathematical derivations of Feynman diagram properties are presented. The induction method used applies to the analytic properties of scattering amplitudes. (L.N.N.)

31511 PARTICLES, FIELD THEORY AND FORCE. R. J. Blin-Stoyle (Oxford Univ.). Contemporary Phys., 2: 325-44(June 1961).

An attempt is made to give a simple account of the basic ideas of quantum field theory. This theory provides a description of the way in which the elementary particles of nature acquire certain properties and accounts for their

interactions with one another. Particular emphasis is laid on the properties of the neutron and proton, nuclear forces, and the electromagnetic properties of the electron. (auth)

31512 THE GYROMAGNETIC RATIO OF THE PROTON. P. Vigoureux (National Physical Lab., Teddington, Middx., Eng.). Contemporary Phys., 2: 360-6(June 1961).

The quotient of the electromagnetic moment to the angular momentum, called the gyromagnetic ratio, would be calculable if to each element of mass was associated to a corresponding element of charge, but as the value thus obtained turns out to be very different from the measured value, roughly 5.6 times smaller in the case of the proton, it is concluded that the knowledge of nuclei is not yet adequate for the calculation of the ratio. However, the behavior of the proton in a magnetic field leads to a simple method of measuring the gyromagnetic ratio. The method consists of observing the frequency of precession of protons in a known magnetic field and applying mechanics to obtain the results. The effect is analogous to that observed for a spinning top with its axis inclined to the vertical. The circuit and apparatus used for measuring the gyromagnetic ratio are described. (N.W.R.)

31513 ELASTIC SCATTERING OF NUCLEONS ON A TARGET WITH SPIN 1. P. Winternitz (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Prague). Czechoslov. J. Phys., B 11, 482-9(1961). (In Russian)

A method, by means of which it is possible to reconstruct a potential on the basis of data on elastic scattering, is investigated for the case of scattering nucleons on targets with spin 1. Formulas are given which express the relations between a phenomenological potential and the elements of the scattering matrix. (auth)

31514 SOME TOPICS REGARDING THE STRONG INTERACTIONS OF STRANGE PARTICLES. D. Amati (Università, Rome and Istituto Nazionale di Fisica Nucleare, Rome) and B. Vitale. Fortsch. Physik, 7: 375-421(1959). (In English)

The properties of strange particles (mass, isobaric spin, strangeness, spin, decay modes, lifetimes, and charge independence in strong interactions) are reviewed. Determinations of the Λ-Σ, K^0-$K^{\pm}$, K-Λ, and K-Σ relative parities are investigated. Symmetries found in strong interactions (charge conservation, charge independence, etc.) are discussed. Several proposed types of symmetry (complete, global, etc.) are reviewed. Parity conservation in strong interactions is examined. (T.F.H.)

31515 ON THE CHERENKOV EMISSION BY MAGNETIC AND ELECTRIC MOMENTS. A. B. Kukanov (Moscow State Univ.). Izvest. Vysshikh Ucheb. Zavedeniĭ, Fiz., No. 2, 28-33(1961). (In Russian)

Cherenkov emission by magnetic and electric moments moving in a medium with complex characteristics ϵ and μ is investigated. An analysis is made of the concept of electric charge and currents and magnetic charges and their currents. (R.V.J.)

31516 CONSTRUCTION OF DEUTERON QUANTUM FIELD THEORY. A. N. Kushnirenko (Kiev State Univ.). Izvest. Vysshikh Ucheb. Zavedeniĭ, Fiz., No. 2, 52-4(1961). (In Russian)

An attempt was made to construct an atomic nucleus quantum-field theory without the aspects of nuclear potential. Approximation expressions were calculated (without nuclear potential) for the Schroedinger equation for a system of nucleon and meson fields. The quantum field theory of deuterons was constructed, and the deuteron binding energy indicated that a system of two nucleons interacting with a meson vacuum are in a bound state. The experiment showed $\Delta E = -2.2$ Mev. (R.V.J.)

31517 ON LORENTZ TRANSFORMATIONS OF THE PSEUDOVECTOR OF ELECTRON BEAM POLARIZATION. Yu. S. Petrov (Kirov Tomsk Polytechnic Inst., USSR). Izvest. Vysshikh Ucheb. Zavedeniĭ, Fiz., No. 2, 175(1961). (In Russian)

Formulas for pseudovector transformation of electron beam polarization previously derived with Lorentz transformation are developed by a different method and in different expression. (R.V.J.)

31518 REFLECTION OF ELECTROMAGNETIC WAVES AT ELECTRON DENSITY RAMPS. Leonard S. Taylor (General Electric Space Sciences Lab., Philadelphia). J. Appl. Phys., 32: 1796-7(Sept. 1961).

An elementary technique sufficient to determine the conditions necessary to effect the phenomona is described, and results are reported. A restriction to the TE wave is made. A Gedanken experiment is described. (L.N.N.)

31519 EXCITED STATES OF MOLECULES AND THE SCATTERING OF FAST ELECTRONS. J. Karle (Naval Research Lab., Washington, D. C.). J. Chem. Phys., 35: 963-9(Sept. 1961).

When fast electrons are scattered by molecules which undergo excitation in the course of the scattering process, the patterns associated with discrete energy losses show the characteristic molecular-diffraction features associated with interatomic distances. A theory is developed in agreement with experimental results thus far obtained which describes the possible forms for these diffraction features, and shows that the molecular scattering does not necessarily disappear on averaging over all states of excitation, as was generally assumed for the incoherent scattering. In developing the theory, the wave function for the molecule is formed from a linear combination of atomic orbitals assumed to be S functions. By means of group theoretical methods the proper linear combinations of S functions may be composed for the possible types of excited electronic states of the molecule. The theoretical analysis also employs the Franck-Condon principle and the Born scattering theory. From the theory developed, it is possible to predict and interpret gross features of the molecular scattering from molecules in the process of excitation. (auth)

31520 THE SPECTRUM AND THE TOTAL INTENSITY OF ELECTROMAGNETIC WAVES SCATTERED FROM AN IONIZED GAS IN THERMAL EQUILIBRIUM IN THE PRESENCE OF A STATIC QUASI-UNIFORM MAGNETIC FIELD. J. Renau, H. Camnitz, and W. Flood (Cornell Aeronautical Lab., Inc., Buffalo). J. Geophys. Research, 66: 2703-32 (Sept. 1961).

The spectrum of electromagnetic waves scattered from thermal electron density fluctuations in an ionized gas in the presence of a static, quasi-uniform, magnetic field was derived through the use of the Nyquist noise theorem. General analytical results of the spectrum are given and graphs presented for the special case of backscattering. (auth)

31521 KINEMATIC STUDY OF THE ELECTRON PRODUCTION OF π MESONS. Paul Kessler (Collège de France, Paris). J. phys. radium, 22: 388-9(June 1961). (In French)

The study which is made on the electron production of π mesons is applicable also to the production of π mesons by other particles which are sufficiently relativistic. More particularly, the study is concerned with the experiments in preparation on the elastic and inelastic scattering of very high energy μ mesons (of the order of one Bev at

least). The kinematic data on elastic scattering are reviewed, and the formula for the determination of the production threshold is derived. The correlation between the recoil nucleus and the momentum of the π meson created is obtained. Numerical applications are shown. (J.S.R.)

31522 THE STRUCTURE OF THE NUCLEON CORE BY THE HARTREE APPROXIMATION. Yasushi Takahashi (Dublin Inst. for Advanced Studies, Dublin). Nuclear Phys., 26: 658-69(1961). (In English)

A method is proposed to investigate the structure of the nucleon core. A set of equations is derived to define the nucleon core and the meson cloud simultaneously. The equations are formulated by a variational method which enables one to find an approximate solution. The size of the nucleon core is estimated for a non-relativistic nucleon interacting with a neutral scalar meson. The coupling constant between nucleon and meson is given by the ratio of the sizes of the core and the cloud. It is shown that for $f^2/4\pi \approx 1$, the core size may be about half that of the meson cloud, where the number of mesons around the nucleon is about one. The generalization to a more realistic case is also suggested. The renormalization is not considered. (auth)

31523 PHOTON-PROTON COLLISION AT (250 ÷ 800) MEV. S. Minami (Osaka City Univ.). Nuovo cimento (10), 21: 401-9(Aug. 1, 1961). (In English)

The photoproduction of pions on protons is studied at 250 to 800 Mev. Photon-proton scattering at these energies is described in terms of shadow scattering caused by photoproduction of pions. The total cross sections for photon-proton scattering show the existence of a strong and broad resonance, corresponding to the second resonance for photoproduction of pions, at about 750 Mev. Since the resonance behavior is strongly reflected in photon-proton scattering, this process may be regarded as a suitable reaction for studying the character of the second resonance. (auth)

31524 CIRCULAR POLARIZATION OF BREMSSTRAHLUNG EMITTED BY A LONGITUDINALLY POLARIZED ELECTRON IN WEIZSÄCKER-WILLIAMS METHOD. Sasabindu Sarkar (Indian Assn. for the Cultivation of Science, Calcutta). Nuovo cimento (10), 21: 410-15(Aug. 1, 1961). (In English)

The circular polarization of bremsstrahlung, produced in the field of a nucleus by a longitudinally polarized electron, is calculated. This method, valid only for extremely high energy of the electron, simplifies the calculations by reducing the problem to one of Compton scattering in a suitable Lorentz frame. (auth)

31525 PHOTOPRODUCTION OF π^0 IN THE COULOMB FIELD OF THE ELECTRON. P. G. Sona (Laboratori CISE, Milan). Nuovo cimento (10), 21: 416-21(Aug. 1, 1961). (In English)

Photoproduction of π^0 may occur in the Coulomb field of the electron. The total cross section is of the same order as that of the γ-nucleus process, divided by Z^2. A formula is given for the π^0 angular distribution in the c.m. system. The possibility is considered of utilizing this process to determine the mean life of π^0. (auth)

31526 THE MASS OF THE MUON'S NEUTRINO. J. Bahcall and R. B. Curtis (Indiana Univ., Bloomington). Nuovo cimento (10), 21: 422-9(Aug. 1, 1961). (In English)

Free muon production and decay are investigated, assuming a non-zero mass of the muon's neutrino (ν_μ). The quantity most sensitive to the mass (m) of the ν_μ is the shape of the electron spectrum from isotropic μ^+-decay, near the maximum electron energy. A probable upper limit of 5 electron masses is set for m, using data on the maximum electron energy. A more accurate evaluation is possible if data are obtained on the shape of the isotropic electron spectrum. (auth)

31527 OBSERVATIONS ON THE LONG-RANGE INTERACTIONS OF PIONS. I. PRELIMINARY RESULTS ON THE COHERENT PRODUCTION OF TWO CHARGED PIONS BY PIONS AT 14 Gev. F. Baldassarre (Università, Bari, Italy), A. Caforio, D. Ferraro, et al. Nuovo cimento (10), 21: 459-68(Aug. 1, 1961). (In English)

A stack of nuclear emulsion is scanned after exposure to a 14-Bev/c π^- beam. Events with three outgoing relativistic tracks ("tridents") are analyzed in order to determine whether the events are consistent with a pion-pair-production process in which the nucleus acts coherently. Examples of such proposed processes are diffraction dissociation and electromagnetic (Coulomb) production. Coherent events are characterized by extremely low momentum transfer to the target nucleus, and by the absence of nuclear excitation. Thirteen "tridents" are found in which none of the outgoing particles is an electron. Five of these events satisfy the criteria for diffraction dissociation, and one of the 5 also satisfies the criteria for Coulomb production of a pion pair. From these data, only upper limits may be set for the cross sections of the proposed processes, because of the existence of incoherent processes. If it is assumed that the one possible case of Coulomb production is an example of a particular mechanism, an upper limit of 440 mb may be deduced for the π-π cross section at the T = J = 1 resonance. (auth)

31528 EXPERIMENTAL RESULTS ON THE PROTON-NUCLEUS COLLISIONS AT 27 GEV IN EMULSION. A. Barbaro-Galtieri (Università, Rome), A. Manfredini, B. Quassiati, C. Castagnoli, A. Gainotti, and I. Ortalli. Nuovo cimento (10), 21: 469-83(Aug. 1, 1961). (In English)

The characteristics of stars produced by collisions of E_p = 27 Bev protons on emulsion nuclei are studied. Multiplicities $n_s = 6.6 \pm 0.1$ and $n_h = 7.2 \pm 0.2$ are obtained. The mean energy of the secondary shower particles is 2.3 ± 0.2 Bev. The energy transfer to the secondary mesons in the l. s. is $K \sim 0.6\ E_p$. From the angular distribution, the mean number of collisions inside the nucleus is found to be 1.1 and and 2.7 for light and heavy nuclei respectively. The mean free path (mfp) for absorption is $\lambda = 38.0 \pm 1.0$ cm which, according to an optical model, corresponds to a nuclear mfp $\lambda_n = (4.3 \pm 0.3)$ fermi. (auth)

31529 DOUBLE PION PRODUCTION IN K-N COLLISIONS. Chia Hwa Chan (Imperial Coll. of Science and Tech., London). Nuovo cimento (10), 21: 500-4(Aug. 1, 1961). (In English)

Double pion production in high energy K-N collisions is calculated, using a model similar to the K' isobar model. Particular attention is given to the reaction $K^- + p \rightarrow K^- + p + \pi^+ + \pi^-$. (auth)

31530 SOLUTIONS OF THE COUPLED S AND P-WAVE EQUATIONS FOR PION-PION SCATTERING. B. H. Bransden (European Organization for Nuclear Research, Geneva), and J. W. Moffat. Nuovo cimento (10), 21: 505-18(Aug. 1, 1961). (In English)

A method is presented for solving numerically the coupled S- and P-wave equations for pion-pion scattering. The equations in question are derived from analyticity, crossing symmetry, and unitarity considerations on the basis of the Mandelstam representation. It is shown that no parameters other than the pion-pion coupling constant enter the low-energy theory. For a range of coupling constant λ, ($-0.45 \leq$

$\lambda \leq 0$), solutions exist that satisfy crossing symmetry. These solutions are characterized by the existence of a low-energy resonance in the P-wave, whose position and width are entirely determined by λ. The corresponding S-wave phase shifts show that scattering in the I = 0 isotopic spin-state is large at low energies. (auth)

31531 RADIATIVE CORRECTIONS TO $\pi^- \rightarrow \pi^0 + e^- + \bar{\nu}$ DECAY. G. Da Prato and G. Putzolu (Comitato Nazionale per l'Energia Nucleare, Rome). Nuovo cimento (10), 21: 541-9(Aug. 1, 1961). (In English)

Radiative corrections are calculated to order e^2, for the transition probabilities of β-decay of the π^- meson. (T.F.H.)

31532 ON THE RADIATIVE DECAY MODE $K^+ \rightarrow \pi^+ + \pi^0 + \gamma$. D. Monti, G. Quareni, and A. Quareni Vignudelli (Universita, Bologna and Istituto Nazionale di Fisica Nucleare, Bologna). Nuovo cimento (10), 21: 550-4(Aug. 1, 1961). (In English)

A decay mode $K^+ \rightarrow \pi^+ + \pi^0 + \gamma$ is observed. This is the third observation of this decay mode. The π^+ energy is 79 ± 1.5 Mev. Taking into account the experimental data, the branching ratio, which corresponds to the energy interval 55 to 80 Mev for the positive pion, is found to be $8 \cdot 10^{-4}$ radiative decays per K^+ decay. Apart from fluctuations, this value might be underestimated by a factor of 2. In order to justify the experimental branching ratio a direct emission term is needed, in addition to the bremsstrahlung term, since the bremsstrahlung could account for a ratio of only $1.6 \cdot 10^{-4}$. (auth)

31533 Y^{*0} EFFECTS IN THE REACTION $K^- + p \rightarrow \Sigma + \pi$ ON COMPLEX NUCLEI. Y. Eisemberg (Weizmann Inst. of Science, Rehovoth, Israel), G. Yekutieli, P. Abrahamson, and D. Kessler. Nuovo cimento (10), 21: 563-6(Aug. 1, 1961). (In English)

The interaction, $K^- + p \rightarrow \Sigma^{\pm} + \pi^{\pm}$, is studied, in order to determine the existence of an intermediate state consisting of a $\Lambda^0\pi$ resonance (Y^{*0}). Thus the process searched for is $K^- + p \rightarrow Y^{*0} \rightarrow \Sigma^{\pm} + \pi^{\pm}$. It is concluded that the Y^{*0} exists, that its mass is 10 to 15 Mev greater than the $Y^{*\pm}$ mass, that its half-width is < 40 Mev, and that about $\frac{1}{3}$ of all the interactions studied proceed via the Y^{*0} channel. (T.F.H.)

31534 LEPTONIC DECAY OF A Σ-HYPERON. B. Bhowmik (Univ. of Delhi). Nuovo cimento (10), 21: 567-70(Aug. 1, 1961). (In English)

An event observed in emulsion is interpreted as a decay $\Sigma^- \rightarrow n + e + \bar{\nu}$. The frequency of Σ^- leptonic decay is calculated to be 7.3%. (T.F.H.)

31535 REMARK ON THE RADIATIVE MUON DECAY IN THE THEORY WITH AN INTERMEDIATE VECTOR MESON. Z. Bialynicka-Birula (Univ. of Rochester, N. Y.). Nuovo cimento (10), 21: 571-3(Aug. 1, 1961). (In English)

The ratio (ρ) of radiative μ decay to the usual μ decay is on the order of 10^{-6}. A renormalizable theory with an intermediate vector meson is proposed, in order to account for the small magnitude of ρ. The calculated ρ is 10^3 times the observed ρ, assuming the magnetic moment (λ) of the intermediate meson to be 0. In order to fit the data, an anomalous $\lambda = -\frac{1}{3}$ must be assigned to the intermediate meson. It is noted that this value of λ is very improbable. (T.F.H.)

31536 ON THE RELATION OF CHARGE AND SPIN. F. Lurçat (Faculté des Sciences, Lille) and L. Michel. Nuovo cimento (10), 21: 574-6(Aug. 1, 1961). (In French)

The equation $[-1]^{(2j)} = [-1]^{(\epsilon_q q + \epsilon_b b + \epsilon_l l)}$ is derived, for elementary particle interactions. The total angular momentum is j; q, b, and l are the electric, baryon, and lepton charges respectively; and ϵ_q, ϵ_b, and ϵ_l are constants that may equal 0 or 1, depending on the physical situation. (T.F.H.)

31537 SOME REMARKS ON LOW ENERGY PION PHENOMENA. J. K. Walker (Laboratoire de l'Accélérateur Linéaire, Orsay, France). Nuovo cimento (10), 21: 577-80(Aug. 1, 1961). (In English)

The cross sections, π^-/π^+ production ratios, Panofsky ratios, and S-wave scattering lengths are calculated for the reactions $\gamma + p \rightarrow n + \pi^+$ and $\gamma + n \rightarrow p + \pi^-$. All calculations are carried out in a region of the kinematical variables such that the momentum transfer is fixed and equal to that occurring at the threshold of the reactions in question. It is thus possible to eliminate the contribution under the dispersion integrals of the unobservable energy region. (T.F.H.)

31538 RATIO OF ATOMIC STOPPING POWER OF GRAPHITE AND DIAMOND FOR 1.1-MEV PROTONS. Sheldon D. Softky (Stanford Research Inst., Menlo Park, Calif.). Phys. Rev., 123: 1685-91(Sept. 1, 1961).

The theory describing energy loss of heavy charged particles in matter predicts that different physical or chemical forms of the same element will have slightly different stopping powers. Since two different forms of a pure element exhibit the same nuclear scattering cross section, it was possible to measure the relative atomic stopping power of graphite and diamond by observing the yields of backscattered protons from thick targets. The atomic stopping power of graphite was measured to be 1.0604 ± 0.0090 times that of diamond (for 1.1-Mev protons). Using the theoretical density of graphite, a calculation based on this result and Brandt's version of stopping theory yields the result that the molecular polarizability of graphite is 4.9 times that of diamond. If this calculation is made using the measured density of graphite, this polarizability ratio is 1.5, in agreement with the theoretical value. (auth)

31539 MODIFIED ANALYSIS OF NUCLEON-NUCLEON SCATTERING. IV. p-p SCATTERING BETWEEN 9.68 AND 98 MEV. Malcolm H. MacGregor, Michael J. Moravcsik, and H. Pierre Noyes (Univ. of California, Livermore). Phys. Rev., 123: 1835-9(Sept. 1, 1961).

Proton-proton scattering experiments at 9.68, 18.2, 19.8, 25.63, 39.4, 46, 66, 68.3, 95, and 98 Mev are analyzed under the assumption that the higher partial waves are correctly represented by the one-pion exchange contribution (OPEC). Although the data do not determine a unique phase shift set at any energy, the theoretically reasonable requirement that the $^1D_2$ phase the positive and the $^3P_2 - ^3F_2$ coupling parameter be negative at 68 and 98 Mev singles out the following solutions (nuclear-bar phase shifts in degrees):

Energy	$^1S_0$	$^1D_2$	$^3P_0$	$^3P_1$	$^3P_2$	ϵ_2
68.3 Mev	30.45°	2.62°	18.59°	−10.49°	6.69°	−2.38°
95 Mev	22.18°	3.87°	14.24°	−11.98°	11.17°	−2.78°

This solution type can be qualitatively followed to both lower and higher energies. Such an extension is shown by Riazuddin to be required by triplet nucleon-nucleon dispersion relations at 4 Mev, is consistent with the best solutions at both 210 and 310 Mev, is qualitatively similar to the requirements of the best phenomenological and semi-phenomenological potential models, and carries the signature of the P phases required for consistency with the final-state interaction in the photodisintegration of the deuteron. An attempt to tie solutions at 9.68, 25.63, and 39.4 Mev together using a three-parameter P-phase energy dependence derived by Fubini and Stanghellini, with two of the

parameters determined by single pion exchange, was qualitatively consistent but quantitatively unsuccessful. Although on the above grounds, it is believed that this is the physically correct solution type in this energy range, the solution is experimentally not unique, and the phase shifts can be varied by a few degrees in a correlated way without doing undue violence to the data. On both counts, it is highly desirable that the triple scattering experiments needed for refining these values be carried through. That only two such experiments at a single angle are needed was recently shown by Iwadare. (auth)

31540 ELECTRON-ELECTRON SCATTERING AT 500 MEV. E. B. Dally (Stanford Univ., Calif.). Phys. Rev., 123: 1840-50(Sept. 1, 1961).

The electron-electron differential scattering cross section has been measured with the use of a 500-Mev electron beam from the Stanford Mark III linear electron accelerator. Deviations were sought from the theoretical cross section as calculated in first-order perturbation theory (Møller scattering). The experimental results were compared with the Møller formula as corrected to the next order in perturbation theory by the work of Tsai. Atomic electrons in a beryllium target foil constituted the target for the electron-electron scattering. The scattered electrons passed through a slit system which defined the angle of scattering and the solid angle. After the particles passed through the slit system, they entered a double-focusing magnetic spectrometer, which analyzed the scattered particles in momentum. The electrons emerging from the spectrometer were detected by a liquid Čerenkov counter. The incident beam was monitored with the use of a Faraday cup and an electronic current integrator. In order to enhance the accuracy of the experiment, the experimental electron-electron scattering was compared to the elastic electron scattering from the target nuclei (Mott scattering). The cross section was measured at approximately 2.6, 3.5 and 4.5 degrees in the laboratory system. These angles correspond to approximately 90, 107, and 120 deg in the center-of-mass system respectively. The theoretical magnitude of the radiative corrections is −5.5, −4.9, and −4.9% for the scattering angles 2.6, 3.5, and 4.5° respectively. The average experimental deviation from the Møller formula found for the above angles was −3.0 (±2.3)%, −3.5 (±2.9)%, and −5.9 (±2.3)%, respectively, where the error cited is total statistical error. In addition to the statistical error there is a maximum estimated ±2% possible systematic error. (auth)

31541 PRELIMINARY ANALYSIS OF PHOTOPRODUCTION OF K MESONS IN THE MANDELSTAM REPRESENTATION. Fayyazuddin (Imperial Coll., London). Phys. Rev., 123: 1882-7(Sept. 1, 1961).

The preliminary analysis essential for the application of the Mandelstam representation to the photoproduction of K mesons was carried out. The analytic properties of individual multipoles were investigated and the positions of the singularities were located. (auth)

31542 NEUTRON-PROTON PHASE-SHIFT ANALYSIS AT 95 Mev. Malcolm H. MacGregor (Univ. of Copenhagen). Phys. Rev., 123: 2154-6(Sept. 15, 1961).

A phase-shift analysis of neutron-proton differential cross section and polarization measurements at 95 Mev was carried out. With the isotopic-spin-one phase shifts taken from the results of proton-proton phase-shift analyses at the same energy, only one set of isotopic-spin-zero phase shifts was obtained that gave a good least-squares fit to the data. The analysis indicates that the forward and backward peaks in the neutron-proton differential cross section at 95 Mev are predominantly triplet- and singlet-spin scattering states, respectively. (auth)

31543 DOUBLE PION PHOTOPRODUCTION IN THE 1.2-Bev REGION. Kiyomi Itabashi (Tokyo Univ.). Phys. Rev., 123: 2157-9(Sept. 15, 1961).

Energy and angular distributions of π^-'s produced by the reaction $\gamma + p \rightarrow p + \pi^+ + \pi^-$, are calculated and the results are compared with the CalTech measurements at (1230 ± 50) Mev. The calculation starts from the static theory for the $(N\pi\gamma)$ system with the source function $v(p) = \xi^2/(\xi^2 + p^2)$, ξ = 4.7 μ, which is of the form proposed by Fubini and Thirring in their analysis of the low-energy π-N phenomena, and considered as a substitute for the form factor of the $(NN\pi)$ vertex. The kinematical effects of the nucleon recoil, which is numerically very important, are also taken into account so as to cover, as much as possible, the drawback of the static theory. The contributions from the nucleon core current, $(\gamma\text{-}3\pi)$ vertex, and the final-state π-π interaction are neglected. The physical reasoning of these approximations is briefly discussed. The results of the calculation agree satisfactorily with the CalTech data and show that, in this energy region, processes other than Drell's peripheral one are still important, as well as the latter. (auth)

31544 ELASTIC SCATTERING AND SINGLE MESON PRODUCTION IN PROTON-PROTON COLLISIONS AT 2.85 Bev. G. A. Smith, H. Courant, E. C. Fowler, H. Kraybill, J. Sandweiss, and H. Taft (Yale Univ., New Haven and Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 123: 2160-7(Sept. 15, 1961).

The Brookhaven National Laboratory twenty-inch liquid hydrogen bubble chamber was exposed to a monoenergetic beam of 2.85-Bev protons, elastically scattered from a carbon target in the internal beam of the Cosmotron. All two-prong events, excluding strange particle events, were studied by the Yale High-Energy Group. The remaining interactions were studied by the Brookhaven Bubble Chamber Group. Elastic scattering was found to be mostly pure diffraction scattering at center-of-mass angles up to about thirty-five degrees. Some phase shift and/or tapering of the proton edge was required to fit the data at larger angles. No polarization effects in the proton-carbon scattering were observed using hydrogen as an analyzer of polarized protons. Nucleonic isobar formation in the $T = {}^3/_2$, $J = {}^3/_2$ state was found to account for a large part of single pion production. High- orbital angular-momentum states were found to be greatly favored in single pion production. The isobar model of Lindenbaum and Sternheimer gave good agreement with the observed nucleon and pion energy spectra. No polarization or alignment effects were observed for the isobar assumed in this model. (auth)

31545 APPLICATIONS OF CONFORMAL MAPPING TO THE PHENONOMOLOGICAL REPRESENTATION OF SCATTERING AMPLITUDES. William R. Frazer (Univ. of California, San Diego and La Jolla). Phys. Rev., 123: 2180-2 (Sept. 15, 1961).

A series representation of scattering amplitudes analytic in cut planes is derived by means of a conformal mapping. The new series has the advantage that in general it converges more rapidly than the conventional power series. An example is considered in which an angular distribution which requires $(\cos\theta)^4$ terms for a good fit requires only second-order terms in the new series. The resulting advantages in using this series in extrapolations to poles are discussed. As a second example, a modified effective-range formula is derived. (auth)

31546 QUANTUM MECHANICAL SYSTEMS WITH INDEFINITE METRIC. [PART] I. E. C. G. Sudarshan (Univ.

of Rochester, N. Y.). Phys. Rev., 123: 2183-93(Sept. 15, 1961). (NYO-9583)

The structure of quantum theories with indefinite metric is studied with the aid of several simple models. It is shown that the pseudo-unitary scattering matrices entering such a theory are not inconsistent with physical interpretation provided a suitable invariant projection of physical state is carried out from among all the states. A relativistic quantum theory of interacting fields is outlined and is suggested as a basis for a dynamical theory of elementary particles. It is argued that the formal introduction of an indefinite metric together with supplementary interpretive postulates may help to reinstate the principle of simplicity in a consistent theory of elementary particles. (auth)

31547 QUANTUM MECHANICAL SYSTEMS WITH INDEFINITE METRIC. [PART] II. Howard J. Schnitzer and E. C. G. Sudarshan (Univ. of Rochester, N. Y.). Phys. Rev., 123: 2193-2201(Sept. 15, 1961). (NYO-9550)

Several simple models, similar to that of Lee, involving indefinite metric are studied. In this connection, a dispersion-theoretic treatment is applied to a simple "equal-mass" model. It is shown that, at least for these models, the scattering amplitude is analytic in the upper-half energy plane provided time-reversal invariance holds; the rules of the dispersion-theoretic formulation in the case of an indefinite metric theory are given. The solution is reinterpreted as the exact solution of a slightly different model, which can also be obtained by Hamiltonian techniques; further techniques are generalized to include recoil in a relativistic no-pair model. Certain basic questions of interpretation are discussed in some detail in the concluding section. (auth)

31548 PROTON-PROTON SCATTERING BELOW 50 MEV. J. Iwadare (Univ. of Pennsylvania, Philadelphia). Proc. Phys. Soc. (London), 78: 185-96(Aug. 1961).

A simple qualitative interpretation of the results of detailed phase shift analyses is attempted for low energy p-p scattering. The following conclusions are obtained: In general, there are four sets of phase shift solutions, two of which correspond to the right sign of the tensor potential. One of them corresponds to the pure tensor potential, the other to a mixture of the tensor and the L.S potentials. To decide between these two possibilities the combined measurements of C_{nn} and one of the triple scattering parameters are the most convenient and feasible experiments. It is also shown that a version of the pion potential proposed by Hamada et al., is compatible with the angular distribution below 5 Mev. (auth)

31549 INTERFERENCE BETWEEN RAYLEIGH AND NUCLEAR RESONANT SCATTERING OF γ-RAYS. P. B. Moon (Univ. of Birmingham, Eng.). Proc. Roy. Soc. (London), A263: 309-22(Sept. 19, 1961).

The possibility of observing interference between nuclear resonant scattering and Rayleigh scattering of γ rays is examined with reference to thermally broadened medium-energy lines such as the 411 kev E2 line of Hg^{198}, recoil-broadened lines of substantial natural width, for example, the 986 kev E1 transition in Sm^{152}, and lines of natural width only, as in Fe^{57}. For the first two examples, where the incident spectral distribution is not of simple form, a graphical method shows that the interference term is small in comparison with the others whenever the resonant scattering is itself a substantial effect, even if full coherence exists between the resonant and Rayleigh components. It remains possible that interference may be observable in other examples of the second class, to which the graphical method could be extended. For the third class, an analytical approach is adopted and leads to the conclusion that coherence should be only partial, in the sense that part of the resonant scattering reflects the character and preserves the phase of the incident radiation, as does the Rayleigh scattering, while part is characteristic of the resonator and has no counterpart in the Rayleigh scattering. If the incident line is far off resonance these two parts of the resonance radiation will have distinctly different frequencies, a single incident line giving a scattered doublet. In some circumstances, interference with Rayleigh scattering may aid the observation of a weak resonance against a strong background. (auth)

31550 THE NON-LEPTONIC DECAYS OF HYPERONS. Ziro Maki and Yoshio Ohnuki (Nagoya Univ., Japan). Progr. Theoret. Phys. (Kyoto), 25: 353-60(Mar. 1961). (In English)

The non-leptonic decays of hyperons are investigated using the Sakata model and the V-A theory of weak interactions. Λ and Σ decays are treated in a unified way. In the latter case, a possibility of interpreting the experimental evidence is given, provided that the structure of Σ-hyperon satisfies suitable conditions. (auth)

31551 SOLUBLE EXAMPLES IN FIELD THEORY WITH FERMI INTERACTIONS. Yasusi Ataka (Kinki Univ., Osaka). Progr. Theoret. Phys. (Kyoto), 25: 369-80(Mar. 1961). (In English)

An example of a soluble field theory with Fermi interactions is proposed. The theory contains two fermion fields N (N = nucleon) and $\bar{N}$, interacting as $N + \bar{N} \rightleftharpoons N + \bar{N}$. It is shown that the limit of the Machida soluble model, in which the probability amplitude for a bare meson identically vanishes, coincides with the present model in the case of separable form factors. The present model is discussed with general form factors, and a second model is mentioned. (auth)

31552 PION THEORY OF NUCLEAR FORCES AND LOW ENERGY P-WAVE PHASE SHIFTS. Shoichiro Otsuki (Nagoya Univ., Japan), Mituo Taketani, Ryozo Tamagaki, and Wataro Watari. Progr. Theoret. Phys. (Kyoto), 25: 427-35(Mar. 1961). (In English)

It is shown that the low-energy behavior of the triplet P-wave phase shifts in p-p scattering below 20 Mev, after being corrected for vacuum polarization, relativistic, and F-wave coupling effects, confirm the existence of the repulsive central tail of the one-pion-exchange potential. (auth)

31553 PION-PION INTERACTION AND NUCLEAR FORCES. Yasunori Fujii (Nihon Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 25: 441-60(Mar. 1961). (In English)

Nuclear potentials arising from the pion-pion resonance in the state I = J = 1 are calculated. Only the potential proportional to $\tau\tau$ is considered. The resonant state is described both in the ρ-meson formalism and in the chain approximation method. The potentials are calculated explicitly in configuration space, first in the ρ-meson formalism, with mass 600 Mev and width ~ 60 Mev. The potentials are found to be of the nature of the two-pion exchange potentials. In particular there appear a strong attractive L-S potential and a repulsive central potential in the ^{3}O-state, a strong repulsive tensor potential in the ^{3}E-state, and a repulsive L-dependent potential in the ^{1}E-state. The calculated tensor potential in the ^{3}E-state and central potential in the ^{3}O-state are considered to be so strong as to violate some of the previously established results. Therefore, examination of the results offers a test for the validity of the pion-pion resonance. The chain approximation method gives similar results. The electromagnetic form factors of the nucleon are examined. (auth)

31554 VARIATIONAL CALCULATION OF THE SCATTERING LENGTHS IN ELECTRON-HYDROGEN SCATTERING. Yasuo Hara, Takashi Ohmura, and Takahiko Yamanouchi (Tokyo Univ.; National Research Council, Ottawa; and Washington Univ., St. Louis). Progr. Theoret Phys. (Kyoto), 25: 467-74(Mar. 1961). (In English)

The non-relativistic Schrödinger equation for electron–hydrogen-atom scattering is solved by a variational method at the limit of zero incident electron energy. Eight- and 5-parameter trial functions are used, for the singlet and triplet states respectively, and the following upper bounds on the scattering length a are obtained, where a_0 is the Bohr radius: $a_s \leqq 6.217a_0$ (singlet), $a_t \leqq 2.272a_0$ (triplet). (auth)

31555 PHOTOPION PRODUCTION AND $(\gamma,3\pi)$ INTERACTION. Masaaki Kato (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 25: 493-507(Mar. 1961). (In English)

The photoproduction reaction $\gamma + p \rightarrow p + \pi^0$ is investigated, in order to obtain information on the $\pi + \gamma \rightarrow \pi + \pi$ $(\gamma,3\pi)$ interaction. A photoproduction amplitude is obtained in terms of the nucleon isovector form factors and the $(\gamma, 3\pi)$ coupling constant. The $(\gamma,3\pi)$ interaction is found to have a fairly large effect on the angular distribution of the π^0 production, especially on the coefficient of cos θ. Comparisons with experiments impose a crude limitation on the magnitude of the coupling constant. (auth)

31556 THE BEHAVIOR OF POLARIZED DEUTERON BEAM IN A MAGNETIC FIELD. O. D. Cheishvili and G. R. Khutsishvili. Trudy Inst. Fiz., Akad. Nauk Gruzin. S.S.R., 6: 53-60(1958). (In Russian)

The double elastic scattering of a deuteron beam in a magnetic field is considered and the expression for the angular distribution is obtained. Experiments with deuteron double elastic scattering in the presence of the magnetic field and without it are discussed. It is shown that double elastic scattering in a magnetic field can give some additional information about the scattering amplitude and the polarization in comparison with double scattering in the absence of the magnetic field. (auth)

31557 POLARIZATION OF DEUTERONS IN ELASTIC SCATTERING. O. D. Cheishvili. Trudy Inst. Fiz., Akad. Nauk Gruzin. S.S.R., 6: 97-139(1958). (In Russian)

The amplitude and the total cross section of deuteron elastic scattering on nuclei with spin zero are calculated. The polarization of deuterons in elastic scattering and the differential cross section for polarized deuterons are also calculated. In this way the differential cross section of double scattering is obtained. All these values are expressed by means of scattering phases. These calculations may be also used for other spin-one particles. Experiments on double and triple scattering that may give the scattering amplitude are discussed. It is shown that triple scattering experiments may give enough information. The amplitude of deuteron scattering on nuclei with spin zero is calculated in Born approximation. The differential cross section of double elastic scattering is calculated and compared with the experimental results. The phase shifts for deuteron scattering on heavy nuclei are calculated in quasiclassical approximation. (auth)

31558 SOME PROBLEMS OF THE THEORY OF HEAVY UNSTABLE PARTICLES. S. G. Matinyan. Trudy Inst. Fiz., Akad. Nauk Gruzin. S.S.R., 6: 173-229(1958). (In Russian)

The energy spectra of K_{e3} and $K_{\mu 3}$ decays were investigated. Polarization and correlation phenomena in parity-nonconserving hyperon decay with spin ½ and spin ⅜ were considered. The investigation gives basic information on the problem of parity nonconservation and also elucidates the problem of time inversion. Strong π-K interactions applied to τ', τ, $\tau^{0\prime}$, τ^0, $K^0_{\mu 3}$, $K^+_{\mu 3}$ decays were investigated. Phenomenological investigation of γ-production of strange particles was carried out. Experiments are proposed to check Peaslee's statical model of strange particle production. Some processes of photoproduction are considered semiclassically taking into account the magnetic moments of hyperons and nucleons. 130 references. (auth)

31559 ON THE ANALYTICAL STRUCTURE OF THE S-FUNCTION OF ELASTIC SCATTERING IN THE CASE OF INFINITE POTENTIALS. V. S. Olkhovskii and Yu. V. Tsekhmistrenko (Kiev State Univ. and Inst. of Physics, Ukrainian SSR). Ukrain. Fiz. Zhur., 6: 149-56(Mar.-Apr. 1961). (In Ukrainian)

The theory of complex variable functions was applied in an analysis of the structure of the S-function of elastic scattering in the case of an infinite potential. Instead of the direct condition of causality, use was made of the condition of completeness of wave functions in the region where the potential is known. It is shown that the presence in the S-function of poles of the nth order, not corresponding to the bound state, means the presence in the potential of the addend $P_n(r)\, e^{-br}$. The other unanalyticities of S are also associated with the existence in the potential of an "exponential tail", but of a more general form. It is also shown that in the case of slow neutron scattering by the potential $V = -1.4/d^2 \exp(-n/d)$, with $d > 2.2 \times 10^{-13}$ cm, there may be a supplementary or "false" resonance not related to the real or virtual energy level of the system. (auth)

31560 ON THE POLARIZATION OF NUCLEONS FORMED DURING DIFFRACTION SPLITTING OF A DEUTERON. V. K. Tartakovskii (Gor'kii State Univ., USSR). Ukrain. Fiz. Zhur., 6: 273-5(Mar.-Apr. 1961). (In Ukrainian)

The polarization of neutrons and protons in deuteron stripping is determined by evaluating spin–orbit interactions. (R.V.J.)

31561 TWO-NUCLEON PROBLEMS WITH SEMI-PHENOMENOLOGICAL MESON THEORETICAL POTENTIAL. I. A. Mityureva, M. M. Perekalin, and I. A. Terent'ev. Vestnik Leningrad. Univ., 16: No. 4, Ser. Fiz. i Khim. No. 1, 19-24(1961). (In Russian)

The two-nucleon potential obtained by the theory of "clothed" particles is numerically calculated. Proton-proton scattering and correction to the magnetic moment of the deuteron were calculated. (tr-auth)

31562 ELECTRON SPECTRA CAUSED BY BREMSSTRAHLUNG RADIATION OF $E_{\gamma max}$ = 80-Mev. S. P. Kruglov, I. V. Lopatin (Leningrad Inst. of Physics and Tech.). Zhur. Tekh. Fiz., 31: 876-87(July 1961). (In Russian)

First, the primary spectrum of electrons produced by bremsstrahlung radiation is determined. These spectra can be obtained for electrons produced in graphite and aluminum with the use of two tables. The tables allow the determination of these spectra from bremsstrahlung radiation with maximum energy right up to 80 Mev. The problem of the attenuation of gamma rays in the material is also discussed and the appropriate corrections are presented. Finally, the net spectrum of electrons found at each layer of graphite and aluminum is obtained from the preliminary calculations of primary spectra. This net electron spectrum, as a function of depth of penetration, is given only for bremsstrahlung of $E_{\gamma max}$ = 80 Mev. The rate of ionization in an air

cavity in graphite and aluminum is computed with the aid of these calculations. These computations are in good agreement with experimental results. (TTT)

Neutron Physics

31563 A SPECIAL MODEL OF A TWO-GROUP APPROACH IN NEUTRON TRANSPORT THEORY. R. Żelazny and A. Kuszell (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw and Univ. of Warsaw). Bull. acad. polon. sci., Sér. sci., math., astron. et phys., 9: 461-6 (1961). (In English)

A special model of a two-group approach in neutron transport theory is presented. It is characterized by the relation $l_1 = l_2$, where l_i denotes a mean free path for the i-th energetic group of protons. This model can be solved exactly. A solution of the system of Boltzmann equations is given and boundary conditions for Milne's problem are formulated. (L.N.N.)

31564 SLOWING DOWN AND DIFFUSION MEASUREMENTS BY PULSED NEUTRON TECHNIQUES. Kenji Sumita and Yoshihiko Kaneko (Japan Atomic Energy Research Inst., Tokyo). J. At. Energy Soc. Japan, 3: 634-50(Aug. 1961). (In Japanese)

A summary of neutron slowing down and diffusion measurements by pulsed neutron techniques is presented. These techniques were successfully used in experimental studies of reactor physics, especially diffusion problems. The theoretical approaches to the diffusion cooling effect and recent developments considering the influence of chemical binding energy are summarized. The basic requirements for instruments and material arrangements are discussed, and the J.A.E.R.I. compact pulsed neutron source (Cockcroft type-200 kv) and time analyzer are shown as examples. The theoretical and experimental results for various moderators are also surveyed. (auth)

31565 SOME TOPICS IN ONE-VELOCITY NEUTRON TRANSPORT THEORY. C. Carter and G. Rowlands (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Energy, Pts. A and B. Reactor Sci. and Technol., 15: 1-21(Sept. 1961).

Recent developments in one-velocity neutron transport theory are reviewed. Emphasis is placed on the most appropriate mathematical methods to use when obtaining numerical solutions on large electronic digital computers and on the possibilities of introducing simple corrections to diffusion theory in the vicinity of sources, boundaries, and strong absorbers. (auth)

31566 ENERGY DISTRIBUTION OF THERMAL NEUTRONS IN A FINITE BERYLLIUM OXIDE ASSEMBLY. L. S. Kothari and P. H. Khubchandani (Atomic Energy Establishment, Trombay, India). J. Nuclear Energy, Pts. A and B. Reactor Sci. and Technol., 15: 30-1(Sept. 1961).

The diffusion cooling constant C was calculated for thermal neutrons in beryllium oxide. The value obtained depended on the variation of the decay factor and on the form of neutron energy distribution assumed. Data are tabular and graphically represented, and comparison is made with previous data. (L.N.N.)

31567 PREPARATION OF A Sb–Be PHOTONEUTRON SOURCE. Gyula Csikai and János Schadek (Inst. of Nuclear Research, Hungarian Academy of Sciences, Debrecen). Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrecen), Közlemények, 3: 59-62(1961). (In Hungarian)

The (γ,n) nuclear reaction is often used as a neutron source; it is endothermic and its energy is equal to the binding energy of the neutrons. The sources thus prepared present the advantage that the energy of the emitted neutrons will be monochromatic whenever monochromatic γ-rays are used; their use is especially desirable whenever the thermal/epithermal flux ratio must be high. For such cases Sb–Be sources are most suitable. For the (γ,n) process only the 1.692- and 2.088-Mev γ-rays of Sb^{124} can be considered; at these energies the cross section of the $Be^9(\gamma,n)Be^8$ reaction is about 10^{-3} barn. The source consists of an 18-mm diameter 23-mm high Be cylinder, prepared by hot-pressing at 500 kg under 15000 kg/cm^2, in the center of which a 5.2-mm diameter Sb rod is placed. The source is activated in its Al container, then encapsulated in stainless steel. Sources have been also prepared by hot-pressing mixed Be and Sb powders. (TTT)

31568 SCATTERING OF LONG WAVE-LENGTH NEUTRONS BY IRRADIATED BERYLLIUM OXIDE. T. M. Sabine, A. W. Pryor, and B. S. Hickman (Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales, Australia). Nature, 191: 1385-6(Sept. 30, 1961).

Experiments were carried out on beryllium oxide specimens irradiated to three different doses. The results are plotted as $\ln(I_u/I_i)$ versus wave length. The amount of extra scattering due to defects increases with neutron dose. For one set of specimens an annealing study was made by repeating the measurements after annealing the specimens at 200°C intervals from 200 to 1400°C. Two distinct effects, a decrease in attenuation near the Bragg cut-off, which anneals steadily from 200 to 1000°C, and an increase at longer wave lengths, which anneals between 1200 and 1400°C. (P.C.H.)

31569 THE SCATTERING OF SLOW NEUTRONS ON WATER, ICE, AND WATER VAPOR. Tasso Springer (Technische Hochschule, Munich). Nukleonik, 3: 110-31 (July 1961). (In German)

From the results of diffraction spectrographic, spectroscopic, thermodynamic, and other changes, a representation on the structure and dynamics of H_2O in all three stages was developed. The translation and torsion oscillations in water and ice were especially treated in detail. The translation oscillation spectrum was decomposed in water, in analogy to ice, into an optical and an acoustical part. The characteristic energies or Debye temperatures were determined approximately from published data. In the calculation of integral neutron cross sections no detailed knowledge of the spectrum is necessary; one obtains an effective Debye temperature of 130°K in water and 215°K in ice. The experimental neutron cross sections $d^2\sigma/dE'\,d\Omega$ and σ_s, lying in the energy range between 10^{-4} and 1 ev, was discussed on the basis of these representations and compared as far as possible with theory. (tr-auth)

31570 A METHOD FOR THE SOLUTION OF THE TRANSPORT EQUATION FOR PLANE CELL PROBLEMS. Jürgen Lieberoth and Manfred Wagner (Entwicklungsabteilung der Firma Interatom, Bensberg, Ger.). Nukleonik, 3: 102-5(July 1961). (In German)

A method for the integration of the transport equation for plane reactor cells is given which is suitable for the application of electronic digital computers of not too small word lengths. In opposition to iteration methods one obtains the exact solution of the differential equation in two calculations. Therefore there is a great reduction in the calculation time. Moreover the tax on the storage capacity is so low that the application of the method is especially

suitable for subprograms in the solution of complex problems. (tr-auth)

31571 ALBEDO PROBLEM FOR A SLAB. Roman Zelazny and Antoni Kuszell (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Physica, 27: 797-9(Aug. 1961). (In English)

The albedo problem, with prescribed incident neutron beams on both surfaces of the slab, is solved by reducing the problem of solving the Boltzmann equation to the problem of solving a Fredholm type integral equation for the expansion coefficients, using the method developed by K. M. Case in the one-velocity neutron transport theory. (N.W.R.)

31572 ELECTRIC POLARIZABILITY OF THE NEUTRON. Akira Kanazawa (Purdue Univ., Lafayette, Ind.) and Smio Tani. Progr. Theoret. Phys. (Kyoto), 25: 514-15(Mar. 1961). (In English)

A complete set of gauge- and Lorentz-invariant matrix elements is found for the interaction $\gamma + N \rightarrow \gamma + N$ (N = nucleon). This set yields the interaction S matrix, which in turn is used to find the neutron electric polarizability. (T.F.H.)

31573 ATTENUATION OF THERMAL NEUTRONS HAVING A MAXWELL VELOCITY DISTRIBUTION BY AN 1/v-ABSORBER SUCH AS BORAL. J. Stickforth (Krupp) WIDIA-Fabrik, [Essen, Ger.]). Tech. Mitt. Krupp, 19: 78-82(June 1961). (In German)

The exponential attenuation of a 1/v absorbing medium is averaged with the velocity distribution of a Maxwell neutron flux. The use of an exponential attenuation law in which an average absorption coefficient has been inserted is proved to be quite incorrect in all cases of practical importance. The author gives a simple approximation function as well as the development of a power series for the function $\mathcal{F}(ns/\sqrt{2kT/m})$ which indicates the transmission of a plate with thickness (s) and the absorption coefficient $\Sigma = \mu/v$ with respect to thermal neutrons of the temperature T (k = Boltzmann constant and m = neutron mass). (auth)

31574 MEASUREMENT OF THE ASYMPTOTIC NEUTRON SPECTRUM IN SIMPLE WATER GEOMETRY. K. H. Beckurts (Kernforschungszentrum, Karlsruhe, Ger.). Z. Naturforsch., 16a: 611-19(June 1961). (In German)

A measurement method is reported which permits the observation of the asymptotic neutron energy spectrum in pulsed neutron fields. The method was applied to simple water geometries (cube with geometric form factors in the range 0.1 to 1 cm^{-2}). The flux spectrum in the middle of the scattering medium and the discharge spectrum were also observed. The diffusion coolant effect, known from integral measurements, can be clearly observed as a displacement of the spectrum with decreasing linear dimensions of the scattering medium. (tr-auth)

31575 ANALOG STUDY OF THE PROBLEM OF THERMALIZATION AND DIFFUSION. Pierre Coet and Jacques Devooght (Universitè Libre, Brussels). p.13-23 of "Seminar on Analogue Methods in Nuclear Energy Problems, Actes—Proceedings, Brussels, April 21-23, 1960." Brussels, Presses Academiques Europeennes, 1961. (In French)

The problem of thermalization in a cell of a heterogeneous reactor was studied using a resistance network. There is no adequate theory for thermalization with diffusion, the analytical methods being ill-adapted to rapid variations in absorption or to heterogeneous structures. The cell treated in plane geometry is made up of a layer of natural U and a layer of graphite. The heavy gas model is used, which is very good for graphite. The temperature is uniform and the absorption cross section is assumed to vary as 1/v to facilitate the analytic treatment. The results show that the perturbation method developed for an infinite homogeneous medium can be extended to heterogeneous media. The description of the spectrum by a temperature equivalent or by a polynomial series development is inadequate. The thermal utilization factor is less sensitive to conditions at the limits. A two-group formalism of thermalization with diffusion is proposed. (T.R.H.)

31576 TABLE OF CROSS SECTIONS FOR FAST NEUTRON REACTIONS. Austin, Texas. Texas Nuclear Corp., 1960. 10p.

Cross sections for neutron reactions (n,2n), (n,p), and (n,α) at about 14 Mev, and (n,γ) at about 0.025 ev, are given for 89 nuclides, from H^1 to Bi^{209}. The decay characteristics of the residual nuclides are also given. (T.F.H.)

Nuclear Properties and Reactions

Refer also to abstracts 30575 and 30731

31577 (AEEW-M-132) A CRITICAL STUDY OF EFFECTIVE FISSION CROSS SECTIONS FOR Pu^{239}, U^{235}, AND U^{233}. J. E. C. Mills and D. L. Reed (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Establishment, Winfrith, Dorset, England). May 1961. 20p.

Evaluation of the effective cross sections for Pu^{239}, U^{235}, and U^{233} were made using the experimentally measured neutron spectrum in a Calder Lattice. The effective cross-sections were obtained as a function of the moderator temperature and were found to be almost identical to those evaluated in a different way. The applicability of the effective cross sections to dilute uranium–graphite reactor systems is closely examined. (auth)

31578 (AFOSR-854) ON THE PARITY NONCONSERVATION INDUCED BY THE UNIVERSAL FERMI INTERACTIONS INTO THE PION-NUCLEON VERTEX. Scientific Note No. 9. D. Flamm and P. G. O. Freund (Vienna. Universität. Institut für Theoretische Physik). May 10, 1961. Contract 61(052)265. 15p.

The problem of whether the interpretation of strong interactions as high-energy effects of the Universal Fermi Interactions (UFI) is consistent with experimental evidence on parity conservation in low-energy nuclear physics is investigated. The parity nonconserving part of the one nucleon of shell π-N vertex, which originates in the UFI (which is considered to be smeared out with a heavy vector boson of such a mass that they bind an extreme relativistic $N-\bar{N}$ pair into a pion) of the nucleons, is evaluated using dispersion methods and is found to have a relative magnitude of order 10^{-5} when compared with the parity conserving part. This yields a parity nonconserving π-N scattering amplitude of the same relative order of magnitude, a result which does not contradict the existing experimental data. (auth)

31579 (ARF-1193-3) SCINTILLATION SPECTROMETER MEASUREMENTS OF CAPTURE GAMMA RAYS FROM NATURAL ELEMENTS. First Quarterly Report, June 15, 1961—September 14, 1961. Reginald C. Greenwood (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Oct. 4, 1961. Contract AT(11-1)-578. 30p.

A program is being carried out to make a compilation of neutron capture gamma ray spectra of the naturally occurring elements, covering both the low and the high energy region, using NaI(Tl) scintillation detectors. A detection system, together with its associated shielding was constructed and tested. Using a $1\frac{1}{2}$ in. × 1 in. NaI(Tl) scintillation detector, low energy capture gamma spectra were obtained for rhodium, indium, and gold in the region from 0 to 550 kev and for iron, samarium, and cadmium in the region from 0 to 1100 kev. A total of ten previously unreported lines was found in the spectra of iron, rhodium, indium, and samarium. (auth)

31580 (CNI-89) STUDIO SULLA PRODUZIONE DI Am^{243} E Cm^{244} MEDIANTE IRRAGIAMENTO DI Pu^{239} IN REATTORI TERMICI. (Study of the Production of Am^{243} and Cm^{244} by Irradiation of Pu in Thermal Reactors). G. Restelli and G. Segre (Italy. Comitato Nazionale per le Ricerche Nucleari. Centro di Studi Nucleari, Ispra). Dec. 1960. 35p.

Calculations are carried out for the amounts of Pu^{239}, Pu^{240}, Pu^{241}, Pu^{242}, Am^{243}, and Cm^{244} produced by long-term irradiations of Pu^{239} in thermal reactors with $\phi_{th}^{av} = 5.10^{13}$, 3.10^{14}, and 5.10^{14} ns/cm^2 sec. The fission-products activities produced in the samples and the shielding requirements are calculated. Examination is made of the chemical technology of the irradiated samples. (auth)

31581 (CRP-1021) NUCLEAR BINDING ENERGIES AND REACTION Q-VALUES FOR HEAVY IONS. A. R. Rutledge (Atomic Energy of Canada Ltd., Chalk River, Ont.). July 1961. 72p. (AECL-1290)

Consistent sets of reaction Q-values are given for nuclear reactions in which C^{12}, N^{14}, and O^{16} are the bombarding particles, the stable nuclei from Li^6 to Mg^{26} are the targets, and all possible particles are emitted from the compound nucleus. Tables of relevant nuclear binding energies and ground state spins and parities, and some reaction channel diagrams, are included. (auth)

31582 (CRRP-1037) THE CADMIUM CROSS SECTION AFTER BURNOUT OF CADMIUM^{113}. A. G. Fowler and R. G. Hart (Atomic Energy of Canada Ltd., Chalk River, Ont.). July 1961. 18p. (AECL-1304)

Cadmium, in the form of CdO powder has been irradiated to such an extent that the Cd-113 with its extremely high cross section is present in its equilibrium amount, kept in equilibrium by the formation of Cd-113 from neutron capture in Cd-112, and by destruction, again by neutron capture. The cadmium cross section, averaged over all the isotopes remaining at this irradiation, was found to equal 1.22 ± 0.06 barns per atom of cadmium. (auth)

31583 (IFA/FT-37) TABLES OF TRANSFORMATION BRACKETS FOR ALPHA EMISSION CALCULATIONS. A. Sandulescu, M. Stihi, and I. Zamfirescu (Academia R. P. R. Institutul de Fizica Atomica, Bucharest). Apr. 14, 1961. 12p.

31584 (JINR-D-768) OBSERVATION OF THE REACTION $\mu^- + He^3 \rightarrow H^3 + \nu$. A. I. Filippov, M. M. Kulyukin, B. Pontekorvo (Pontecorvo), Yu. A. Scherbakov, R. M. Sulyaev, V. M. Tsupko-Sitnikov, and O. A. Zaimidoroga (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1961. 9p.

An investigation was made of the reaction $\mu^- + He^3 \rightarrow H^3 + \nu$ in a diffusion chamber filled with He^3 at a pressure of 20 atm. About 6000 photographs of meson stopping were obtained and 14 events of muon capture in He^3 with emission of H^3 and a neutrino in the final state were observed. The mean range of tritium determined on the basis of 14 cases was 2.37 ± 0.02 mg/cm^2. The upper limit of the mass of the neutral particle emitted in the process of muon capture by nucleons was calculated to be less than 6 Mev with a probability of 99%. The probability of the reaction was calculated. (M.C.G.)

31585 (JINR-P-305) OB OPREDELENII CHASTOTY ZAKHVATA MEDLENNYKH MEZONOV LEGKIMI I TYAZHELYMI YADRAMI EMUL'SII. (On Determining the Frequency of Slow Meson Capture by Light and Heavy Emulsion Nuclei). D. K. Kopylova, Yu. B. Korolevich, N. I. Petukhova, and M. I. Podgoretskii (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1959. 5p.

A simple method is suggested for determining the percentage of interactions taking place on light and heavy nuclei. The method is demonstrated with nuclear capture of stopped π mesons. It is shown that when stopped π mesons produce auger electrons the capture takes place in heavy nuclei. Capture in light nuclei forms σ_π stars containing particles with ≤50 μ tracks (sub-barrier particles). (R.V.J.)

31586 (JINR-P-754) RASSEYANIE PROTONA NA PROTONE PRI ENERGII 8,5 BEV. (Proton Scattering on Proton at 8.5 Bev). Ying-seb To, L. F. Kirillova, P. K. Markov, L. G. Popova, I. N. Silin, E. N. Tsyganov, M. G. Shafranova, B. A. Shakhbazyan, and A. A. Yuldashev (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1961. 17p.

Elastic p-p scattering was investigated by the emulsion method at an energy of 8.5 Bev. The geometry of exposing was used at which the beam of incident protons is directed perpendicular to the emulsion plane. All in all, 480 events of elastic scattering were found. The total cross section for elastic scattering is equal to 8.74 ± 0.40 mb. The differential cross section was investigated in the angle interval of 1.5 to 20.5° in the c.m.s. The experimental data are in agreement with the simple nucleon model in which the real part of the phase shifts and the dependence of the interaction cross section on the spin state is neglected. The total p-p interaction cross section calculated under these assumptions from the experimental data obtained in this investigation is greater than that measured experimentally by a threefold error. In order to answer the question whether this is due to the real part of the scattering amplitude or its dependence on the spin state a considerably higher accuracy is necessary. One can, however, assert that the real part of the scattering amplitude does not exceed 0.5 1m $f(\theta)$. The root-mean-square radius of the proton-proton interaction is found to be equal to 1.15 ± 0.05 f. (auth)

31587 (JINR-P-761) VLIYANIE DEFORMATSII NA PROTSESS UPRUGOGO RASSEYANIYA ATOMNYKH YADER. (Effects of Deformation on the Elastic Scattering of Atomic Nuclei). B. N. Kalinkin and San-ha Oum (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Reactors). 1961. 11p.

The effect of nuclear deformation on elastic scattering process was investigated with O^{16} and Ne^{20} ions on Pb^{208} targets. An approximate evaluation of the effect indicates that it can be found. (tr-auth)

31588 (NP-10737) ROTATIONAL ENERGIES OF ASYMMETRIC ODD-A NUCLEI AND NUCLEI WITH A AROUND 190. Karl T. Hecht and G. R. Satchler (Michigan. Univ., Ann Arbor. Coll. of Literature, Science, and the Arts and Oak Ridge National Lab., Tenn.). Aug. 1961. Contract Nonr-1224(15). 73p.

The asymmetric rotator model of Davydov and Filippov was extended to odd-A nuclei by coupling a single nucleon to an inert core of well stabilized asymmetric equilibrium shape. Rotational energies were calculated for states with spin I through numerical diagonalization of $(I + \frac{1}{2}) \times (I + \frac{1}{2})$ rotational matrices which depend in a complicated way on the state of the odd nucleon. The state of the odd nucleon is described by single particle wave functions such as those calculated by Newton, generalizations for the asymmetric case of the wave functions computed by Nilsson for axially symmetric nuclei. In many cases the rotational spectra may consist of several well separated or overlapping sequences of spin states which resemble the rotational bands of axially symmetric nuclei. In an initial survey of odd-A nuclei around A of 190 no clearcut evidence was found for the existence of nuclei with a well defined asymmetric equilibrium shape. Calculations for Ir^{191} and Re^{185} indicated only that it may be very difficult to distinguish between a symmetric and an asymmetric rotator model when the asymmetry is small. Calculations for Pt^{195} showed that, although the observed level scheme can be reproduced by asymmetric rotator theory, the observed electromagnetic transition probabilities are not in agreement with the predictions of the simple asymmetric rotator model. (auth)

31589 (NP-10760) THE NUCLEAR PROPERTIES OF RHENIUM. Seventh Quarterly Technical Progress Report, June 8, 1961–September 8, 1961. R. A. Karam (Florida. Univ., Gainesville). Contract NOas 60-6021-c. 17p.

Experiments designed to separate gamma pulses from neutron pulses in NaI(Tl) were carried out. A 5-mc Co^{60} source was used with a beam of neutrons and gamma rays to test the method of separation. The pulse-height distributions obtained with the source in the beam were treated in the separation as if the Co^{60} radiations were part of the gamma rays in the reactor. Another set of experiments were performed without the source. Each set was separated to give the gamma and neutron contributions to the total pulse-height distribution. The difference in areas under the 1.33 Mev peak between the two sets was 9016 cpm, and for the 1.17 Mev peak was 9686 cpm. These values differed from the true values, as determined from the Co^{60} alone, by 8.4 and 0.23%, respectively. (auth)

31590 (NP-10762) CORRELATED PROTON–PROTON PAIRS FROM THE HIGH ENERGY PHOTODISINTEGRATION OF LIGHT NUCLEI. Technical Report No. 27. Alan V. Larson and James H. Smith (Illinois. Univ., Urbana. Physics Research Lab.). Aug. 1961. Contract ONR 1834 (05). 142p.

Targets of He, Li, C, and Al were irradiated by bremsstrahlung of 257 Mev maximum photon energy. Photodisintegrations which involved two fast protons were observed. Energy and angular distributions of the coincident protons, one of which was always observed at a laboratory angle corresponding roughly to 90° in the center of mass of the two protons, were measured. It was concluded that the primary absorption of the photon occurs on neutron-proton paris. The proton-proton pairs arose from subsequent internal scattering of the primary photoneutron form other protons in the nucleus. No evidence was seen that mesons are reabsorbed on nucleon pairs which do not include the parent nucleon. An upper limit was established for this process. This experiment supported the photomeson production models which do not depend upon the true absorption of mesons as they pass through nuclear matter. (auth)

31591 (PAN-251/VI) SEMI-CLASSICAL TREATMENT OF MULTIPLE MESON PRODUCTION AS A BREMSSTRAHLUNG PROCESS IN HIGH ENERGY NUCLEON-NUCLEON COLLISION. Z. Chyliński (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). June 1961. 28p.

Multiple meson production was treated as a Bremsstrahlung process. The assumed scalar coupling led to a strong interaction between high energy nucleons resulting in high momentum transfer and high multiplicity of the process. The interaction time was identified with the time of the passage through the strong interacting region. A nucleon core was introduced to cut-off the energy of the secondaries to a reasonable value. The coupling constant for pion and nucleon field was estimated. The numerical results concerning the angular distribution, spectra of the momenta, and transverse momenta of the secondary particles and their multiplicity for different values of the parameters used in the description are given. (auth)

31592 (TID-13419) STUDIES IN NUCLEAR SPECTROSCOPY. Technical Progress Report, July 1, 1960 through June 30, 1961. Richard C. Pilger, Jr. (University of Notre Dame, Notre Dame, Ind.). Contract AT(11-1)-834. 10p.

The decay scheme of Lu^{173} is investigated and interpreted, and the properties of the energy levels in the daughter Yb^{173} are studied. A $(^3/_2^+)$ level is reported in Yb^{173} at 413.3 kev. The M1 and E2 transition probabilities for the observed gamma rays are calculated. (T.F.H.)

31593 (TID-13919) DECAY OF Nb^{94}. R. E. Sund, L. I. Yin, R. G. Arns, and M. L. Wiedenbeck (Michigan Univ., Ann Arbor. Harrison M. Randall Lab. of Physics). [1961]. Contract AT(11-1)-684. 7p.

Gamma rays in Mo^{94} following the decay of Nb^{94} were studied using coincidence and directional correlation measurements. The 700-kev transition was found to be in coincidence with the 873-kev gamma ray. The intensity of the crossover transition of 1573 kev was found to be less than 0.1% of the 873-kev gamma ray intensity. Directional correlation measurements for the 700-kev to 873-kev cascade were taken at seven angles in each quadrant, and the corrected expansion coefficients were found to be $A_2 = 0.0965 \pm 0.0076$ and $A_4 = 0.019 \pm 0.011$. These data indicate spins of 4 and 2 for the 1573-kev and 873-kev levels respectively. (auth)

31594 (AEC-tr-4445) REPORTS AT THE CONFERENCE ON NUCLEAR REACTIONS INDUCED BY MULTICHARGE IONS. Translated by Lydia Venters (Argonne National Lab., Ill.) from Materialy Konf. po Yader. Reaktsiyam s Mnogozariad. Ionami, Dubna, 1958.

A total of 16 papers is presented for each of which separate abstracts were prepared. (J.R.D.)

31595 (AEC-tr-4445(p.3-15)) BASIC PROBLEMS OF THE PHYSICS OF MULTICHARGE IONS. G. N. Flerov. (Translation)

A review of methods for obtaining multicharge ions is presented. Problems in obtaining transuranic elements are also discussed. It is noted that the use of heavy ions will allow introduction of a series of qualitatively new concepts. It is recommended that to achieve successful work in the transuranic region, the intensities of particle beams must be increased, and their range extended. (J.R.D.)

31596 (AEC-tr-4445(p.16-28)) INVESTIGATION OF THE PROPERTIES OF HIGHLY EXCITED COMPOUND NUCLEI. A. S. Karamian. (Translation)

Investigations of excited compound nuclei are discussed in which the union of nuclei participating in such reactions occurs following formation of a compound nucleus. Tests

associated with the hypothesis that impinging nuclei form a compound system in which the total excitation energy is distributed among all nucleons almost uniformly are reported. It is concluded that results do not clearly point to a solution of problems raised in the investigation but rather to bases for further investigations. (J.R.D.)

31597 (AEC-tr-4445(p.29-34)) IN OBTAINING THE 102ND ELEMENT. D. M. Parfanovich. (Translation)

A review of research leading to discovery of element 102 is presented. Information contained in a paper published by a group of American, English, and Swedish scientists related to the discovery of Nobelium is examined and work in Russian laboratories on exposure of Pu to accelerated O ions is reported. (J.R.D.)

31598 (AEC-tr-4445(p.35-8)) INVESTIGATION OF EXCITED NUCLEAR STATES BY THE MULTICHARGE ION METHOD. V. S. Shpinel'. (Translation)

Nuclear structure of odd nuclei located near closed shells is discussed. An analysis of the finer effects and mechanisms is presented in an effort to explain quantitatively the magnetic moment, quadrupole moment, transition probabilities and other nuclear properties. (J.R.D.)

31599 (AEC-tr-4445(p.39-44)) POSSIBILITY OF EXISTING PROTON-RADIOACTIVE NUCLEI. V. A. Karnaukhov. (Translation)

In a discussion of proton emission by existing nuclei during radioactive decay, experiments designed to detect such emission are evaluated, and various possible assumptions which may be useful are examined. It is assumed that protons can emerge from nuclei which are at ground state (proton decay), and that delayed protons may emerge. Examples of nuclei which may be obtained by means of multicharge ions are given. It is noted that by depletion of neutrons in reactions with multicharge ions, nuclei may be obtained that are unstable to proton decay. (J.R.D.)

31600 (AEC-tr-4445(p.45-61)) INVESTIGATION OF THE FRACTIONAL NUCLEAR INTERACTION. V. V. Volkov. (Translation)

Cases in which the interaction forces acting in the region of target nuclei and multicharge ions are insufficient for effecting combination of these particles and the compound nuclei are examined. Supporting data are discussed and in summary the reactions are denoted as exchange reactions. In such reactions the nucleon or group of nucleons migrates from the target nucleus to the bombarding nuclei, and conversely. (J.R.D.)

31601 (AEC-tr-4445(p.62-74)) USE OF THE MASS-SPECTROSCOPIC METHOD FOR INVESTIGATING REACTIONS INDUCED BY HEAVY PARTICLES. N. I. Tarantin. (Translation)

Nuclear reactions that occur with heavy particles are discussed in relation to the use of highly sensitive spectrometers in such work. Investigations are reported in which the yield of stable and long-lived nuclei is taken into account, and an evaluation is made on the basis of an assumption that charge distribution of fissioning nuclei between two fission fragments complies with the postulate of equality of beta-decay chain length. (J.R.D.)

31602 (AEC-tr-4445(p.75-8)) RANGE-ENERGY RELATIONSHIP FOR IONS IN DIFFERENT MEDIA. Yu. Ts. Oganesyan (Oganesian). (Translation)

Work is described pertaining to the range-energy relationship for C, N, and O ions at 50 to 110 Mev in various substances. (J.R.D.)

31603 (AEC-tr-4445(p.79-84)) FORMATION OF NEW ISOMERS IN NUCLEI EXPOSED TO MULTICHARGE IONS. L. I. Rusinov. (Translation)

The possibility of forming new isomers by irradiation of nuclei with multicharge ions is discussed. The energy region in which the appearance of these isomers may be expected is also examined. Included is a discussion of Mo^{93} isomerism. (J.R.D.)

31604 (AEC-tr-4445(p.85-91)) ACCELERATOR OF MULTICHARGE IONS. K. L. Pliusnin. (Translation)

Design of a cyclotron for acceleration of multicharge ions is described. A brief description of the laboratory to be built as a part of the facility is also given. (J.R.D.)

31605 (AEC-tr-4445(p.92-8)) CONFIGURATION OF THE MAGNETIC FIELD OF MULTI-CHARGE ION ACCELERATOR AND CALCULATION OF THE BEAM OUTPUT. I. M. Matora. (Translation)

Peculiarities of design and construction of cyclic multicharge ion accelerators are described. Cyclotron beam output is discussed along with electric field uniformity and beam focusing. (J.R.D.)

31606 (AEC-tr-4445(p.99-104)) CYCLOTRON MULTICHARGE ION SOURCE. B. N. Makov. (Translation)

The design of a cyclotron multicharge ion source is described. (J.R.D.)

31607 (AEC-tr-4445(p.105-8)) OPERATION OF A MULTICHARGE ION SOURCE IN THE CYCLOTRON OF THE INSTITUTE OF ATOMIC ENERGY. . A. S. Pasiuk. (Translation)

The use of a 150-mm polar diameter source in a cyclotron is outlined. Multicharge ions at the final radius were obtained as follows: C^{+4} of the order of 5 μa, N^{+5} of the order of 1 μa, and O^{+5} of the order of 0.5 μa. (J.R.D.)

31608 (AEC-tr-4445(p.109-17)) SPECIFIC FEATURES OF RADIOCHEMICAL INVESTIGATIONS OF NUCLEAR INTERACTION PRODUCTS USING MULTICHARGE IONS. Yu. B. Gerlit. (Translation)

Methods used in radiochemical investigations of nuclear interaction products are discussed. The use of carriers is discussed along with isotopic exchange reactions and chromatography. (J.R.D.)

31609 (AEC-tr-4445(p.118-31)) SEVERAL CHEMICAL AND RADIOCHEMICAL PROBLEMS IN OBTAINING AND INVESTIGATING NEW ELEMENTS. G. N. Flerov. (Translation)

Difficulties in investigating new elements are summarized by posing questions concerning new element chemical purity and interpretation of experimental results. Plans for checking the entire procedure for identification of transplutonic elements are included. (J.R.D.)

31610 (AEC-tr-4828) HANDBOOK ON NUCLEAR PHYSICS CONSTANTS FOR REACTOR CALCULATIONS. I. V. Gordeev, D. A. Kardashev, and A. V. Malyshev. Translated from extracts of chapters I-V of "Spravochnik po Yaderno-Fizicheskim Konstantam dlya Raschetov Reaktorov." (A publication from the Publishing House of the State Committee of the Council of Ministers of the USSR on the Applications of Atomic Energy, Moscow, 1960). 13p.

Excerpts from the Handbook on Nuclear Physics Constants for Reactor Calculations are presented. Cross sections of thermal neutrons, parameters of isolated resonance levels, transport cross sections and cross sections of inelastic scattering, cross sections of radiative capture

of intermediate and fast neutrons, and energy and yield of fission neutrons are discussed. (M.C.G.)

31611 INTERACTIONS OF π^+ MESONS WITH HYDROGEN AND CARBON AT 78 MEV. D. V. Neagu and R. G. Salukvadze (Joint Inst. for Nuclear Research, Dubna, USSR and Tbilisi Inst. of Physics, Academy of Sciences, Georgian SSR). Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz. Studii cercetări fiz., 12: No. 1, 39-54(1961). (In Rumanian)

Interactions of 78 ± 2.35 Mev π^+ mesons with hydrogen and carbon were studied by means of a propane bubble chamber. The elastic scattering cross section $\sigma(\pi^+, p)$ = (38.85 ± 5.95) mb and the total scattering cross section $\sigma(\pi^+, C)$ = 166 ± 13.6 mb were determined. Angular distributions and the absorption cross section $\sigma_{abs}(\pi^+, C)$ = (180 ± 20) mb were also determined. Star distribution by the number of prongs is described by $\bar{t}$ = 2.50 ± 0.18. The angular distribution of prongs in relation to the incident meson is anisotropic with a coefficient $(N\uparrow - N\downarrow / N\uparrow - N\downarrow)$ = 0.13 ± 0.02. Seventy percent of the absorption takes place through capture by nucleon pairs, while in the rest of the cases, a larger complex of nucleons participate in the capture. (R.V.J.)

31612 METHOD OF THE FAST ADIABATIC PASSAGE IN NUCLEAR MAGNETIC RESONANCE. A. Valeriu (Inst. for Nuclear Physics, Bucharest). Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz. Studii cercetări fiz., 12: No. 1, 67-73(1961). (In Rumanian)

The nuclear magnetic resonance signal has special features when passage through resonance is fast and adiabatic. These features are explained. (tr-auth)

31613 ASYMPTOTIC PHASE DISPLACEMENT AND THE DIFFERENTIAL SCATTERING CROSS SECTION OF ELECTRONS ON ATOMS WITH LATTER POTENTIAL. T. Tietz (Univ. of Lodz, Poland). Ann. Physik (7), 8: 99-103(1961). (In German)

A closed formula for the phases in the coherent scattering of electrons on the Thomas-Fermi atom was derived for the Latter potential with the help of the asymptotic Wenzel-Kramers-Brillouin approximation. The Thomas-Fermi function of the free neutral atoms was approximated with the Buchdahl approximation solution. The differential scattering cross section of the electrons for the Latter potential was derived. (tr-auth)

31614 EXCITED STATES OF ^{64}Zn. M. J. Kenny and D. E. Caro (Univ. of Melbourne). Australian J. Phys., 14: 242-9(June 1961).

The reaction $Cu^{63}(p,n)Zn^{63}$ was studied at bombarding energies between 5 and 11.5 Mev using an activation technique with good energy resolution. Previously unknown levels in Zn^{64} at excitation energies of approximately 13.3_7, 13.7_5, 14.1_2, 14.3_1, 14.9_0, 15.1_8, 15.6_1, and 15.7_7 Mev were found. It is shown that six of these levels, and the observed absence of levels in some energy regions, can be accounted for in terms of Nilsson's calculations for the single-particle states of a deformed nucleus. If this interpretation is correct, the deformation of Zn^{64} must be negative, at least in its highly excited states. (auth)

31615 SUM-COINCIDENCE MEASUREMENTS ON ^{154}Eu. A. W. Parker (Univ. of Melbourne). Australian J. Phys., 14: 250-9(June 1961).

By examining γ rays from the radioisotope Eu^{154} with a fast-slow sum-coincidence spectrometer any β transition to a possible 1.82 Mev level in Gd^{154} is shown to have an abundance less than 1% of that of the β transition to the neighboring 1.72 Mev level. The presence of a 1.60 Mev γ ray from the 1.72 Mev level is confirmed; the intensity of this γ ray was found to be 6.4% of that of the 1.28 Mev γ ray. (auth)

31616 THE BRANCHING RATIO OF THORIUM C (BISMUTH-212). José Gomes Ferreira, Maria Teresa Goncalves, and Lidia Ferreira-Salgueiro. Compt. rend., 253: 98-9(July 3, 1961). (In French)

A new determination of the branching ratio of ThC was made with nuclear emulsions. A value $\alpha/(\alpha - \beta)$ = 0.351 ± 0.006 was found in good agreement with recent works. (tr-auth)

31617 CROSS SECTION OF THE DECAY OF CARBON-12 INTO THREE α PARTICLES PRODUCED BY 90-MEV PROTONS AND THE PROBABILITY OF A TRANSITORY α STRUCTURE. Henri Gauvin, Raymond Chastel, and Leopold Vigneron (Faculte des Sciences de Paris, Orsay, France and Faculte des Sciences de Bordeaux-Talence, Gironde, France). Compt. rend., 253: 257-9(July 1961). (In French)

The cross section of the reaction $C^{12}(p,p')3\alpha$, induced in a stack of nuclear emulsions by 90-Mev protons, was determined. The value obtained was σ = 5.4 ± 0.9 mb. Eight events showed an α particle with the energy E ≥ 30 Mev. A comparison with the total cross section for the elastic scattering $p-He^4$ has permitted a probability for the presence of an eventual transitory α structure to be estimated at 0.30. (tr-auth)

31618 THE BASIC PROPERTIES OF THE SUPERFLUID MODEL OF THE NUCLEUS. V. G. Solov'ev (Joint Inst. for Nuclear Research, Dubna, USSR). Doklady Akad. Nauk S.S.S.R., 139: 847-50(Aug. 1, 1961). (In Russian)

The superfluid model of the nucleus can correctly explain many of the regularities in the behavior of complex nuclei. The characteristics of superfluid states and the behavior of the levels of an even-even system versus the magnitude of the constant for pair interaction G, the superfluid properties of the two-quasi-particle, excited states of a system, and the specific features of the 0+ states are investigated. A value of G = 0.020 $\hbar\,\omega_0$ ($\hbar\omega_0 = 41\ A^{-0.33}$ Mev) was calculated on the basis of the superfluid model of the nucleus by comparing the experimental value for the energy of pair formation with the energy of the single-particle levels in a neighboring odd nucleus. The behavior of the principal state of the system with increasing values of G is examined. Energy values of the principal state and slit values of 2C are presented graphically for G values of 0.016, 0.020 and 0.024 $\hbar\,\omega_0$. At G = 0.028 $\hbar\,\omega_0$, the energy of the principal state decreases by 0.70 $\hbar\,\omega_0$ = 5.1 Mev, while C = 0.28 $\hbar\,\omega_0$ − 2.1 Mev. At G = 0.032 $\hbar\,\omega_0$, the correlation function of the principal state C = 0.37 $\hbar\,\omega_0$ = 2.7 Mev, while the energy decreases by 1.17 $\hbar\,\omega_0$ = 8.5 Mev and C^2/G = 30.5 Mev, an increase in energy of 22 Mev for the system due to disappearance of the Fermi surface. The energy of the excited states of the system was calculated from the formula $\sqrt{C^2 + [E(i) - \lambda]^2} + \sqrt{C^2 + [E(e) - \lambda]^2}$. Here λ is the chemical potential and E (i) is the energy of the i-level for an average field. It was shown that there is a significant gap in the states available for pairing in strongly-deformed nuclei. The specific features of the superfluid model of the nucleus are important at values of G = 0.020 $\hbar\,\omega_0$, but these features are absent at values of G twice as large. (TTT)

31619 THE METHOD OF PULSED NEUTRONS APPLIED TO THE DETERMINATION OF THE NUCLEAR

CONSTANTS OF GRAPHITE. Jean Lalande (Centre d'Etudes Nucleaires, Grenoble, France). Inds. atomiques, 5: No. 5-6, 71-6(1961). (In French)

A method permitting the determination of the nuclear constants σ_a and λ_t of a moderator is described. The decrease in time of a neutron pulse introduced into a finite medium is studied. This decrease of the thermal neutron density is the product of two exponentials: one representing absorption and the other leaks. By variation of one or the other of these factors, the constants of the factor left invariant can be determined, and from this the values of the nuclear constants can be deduced. (tr-auth)

31620 THE GAMMA-RAY SPECTROMETRY OF FISSION PRODUCTS. VI. THE CALCULATED AND EXPERIMENTAL GAMMA-RAY SCINTILLATION SPECTRA OF U^{235} FISSION PRODUCTS WITH CYLINDRICAL NaI (Tl) CRYSTALS. Ichiro Hattori (Technical Research Lab., Ishikawajima-Harima Heavy Ind. Co., Ltd., [Japan]). J. At. Energy Soc. Japan, 3: 581-9(Aug. 1961). (In Japanese)

The calculation of scintillation spectra for the broad parallel γ rays emitted from U^{235} fission products incident on a right circular cylindrical NaI (Tl) crystals is presented. Typical scintillation spectra from fission products are presented. The parameters of the spectra were tabulated as functions of time after fission. The calculated spectra with a 1.75-in.-dia × 1 in. crystal were practically the same as those with a well-type crystal. With a 4 in.-dia × 4 in. crystal, however, the relative height of peaks in the lower energy range become lower, whereas peak in the higher energy range became higher than those with a well-type crystal. All peaks tend to be equalized in relative height for larger crystals. Samples of fission products were measured with a 1.75-in.-dia × 1 in. NaI(Tl) crystal and with a 1-in.-dia × 1 in. anthracene crystal by both conventional and two-crystal scintillation spectrometers. In the latter, Compton continuum was automatically subtracted. In general, the resolution of cylindrical crystals was better than that of well-type, and the more detailed structures were more observable with cylindrical crystals. Accordingly, to deduce the ages of fission products, the former was more useful than the latter. Comparison of the experimental with the calculated spectra shows a good agreement except at the peaks. In addition, the calculated spectrum was compared with other experimental spectra. Although the conditions of the experiments were not always equal to the assumption for the calculation, good agreement was found. (auth)

31621 NUCLEAR QUADRUPOLE RESONANCE IN $TiCl_4$, $ThCl_4$, $NbCl_5$, AND $TaCl_5$. Allan H. Reddoch (Univ. of California, Berkeley). J. Chem. Phys., 35: 1085-9 (Sept. 1961). (UCRL-8972-R)

The chlorine resonance in titanium tetrachloride was re-examined, confirming the existence of four resonances. A chlorine-35 resonance at about 6 Mc was discovered in thorium tetrachloride. The frequency suggests highly ionic bonding, which contradicts earlier conclusions from x-ray studies. Some double-bond character may be present in the Th–Cl bond. Niobium and chlorine resonances were discovered in niobium pentachloride. The niobium resonances are described by a single set of parameters, the coupling constant eqQ being approximately 78 Mc, and the asymmetry parameter, $\eta = 0.32$. Because of the large asymmetry parameter, it was possible to observe two $\Delta M = 2$ and one $\Delta M = 3$ transitions. Only a single Cl^{35} resonance was found at about 13 Mc, although two more chlorine resonances would be expected on the basis of crystal structure. The frequency of the chlorine resonance suggests appreciable covalency in the niobium–chlorine bond in niobium pentachloride. A single resonance was found in tantalum pentachloride at about 13 Mc. It is believed to be a chlorine-35 resonance. A fairly simple method is outlined for determining the asymmetry parameter of the electric-field gradient from the observed transition frequencies without directly solving the secular equations. (auth)

31622 THE ESTABLISHMENT OF AN ABSOLUTELY CALIBRATED NEUTRON SOURCE. E. J. Axton and P. Cross (National Physical Lab., Teddington, Middx., Eng.). J. Nuclear Energy, Pts. A and B. Reactor Sci. and Technol., 15: 22-7(Sept. 1961).

A 400 mc Ra–Be photoneutron source was adopted as the national standard source. It was calibrated by the method of absolute determination of Mn^{56} produced in the $Mn^{55}(n,\gamma)Mn^{56}$ reaction. The calibration agrees within 1% with an international average. The standard error is ±1%. The error is mainly due to the uncertainty in the knowledge of the manganese and hydrogen thermal neutron capture cross sections. In addition there may be a systematic error not exceeding 1.0% associated with $4\pi\beta$ proportional counting. (auth)

31623 ABSORPTION IN THE 6.7 ev RESONANCE OF U^{238}. B. P. Rastogi and R. S. Singh (Atomic Energy Establishment, Trombay, India). J. Nuclear Energy, Pts. A and B. Reactor Sci. and Technol., 15: 29-30(Sept. 1961).

Resonance sorption probabilities in homogeneous mixtures of U^{238} and H at 6.7 ev were calculated. The theoretical derivation is presented. Data obtained from the resulting equation are compared with that obtained by the narrow resonance, and the narrow resonance is compared with the infinitely heavy absorber methods. (L.N.N.)

31624 STUDY OF THE REACTIONS PRODUCED BY Li^6 IONS ON BERYLLIUM. C. Lemeille (Centre d'Etudes Nucléaires, Saclay, France), L. Marquez, N. Saunier, and M. Coste. J. phys. radium, 22: 349-52(June 1961). (In French)

The nuclear reactions produced by Li^6 ions of energy up to 2 Mev on Be were studied. The results obtained by scintillation counters, nuclear plates, and junctions are presented. Possible reaction mechanisms are discussed. (auth)

31625 THEORETICAL AND EXPERIMENTAL DETERMINATION OF THE BREMSSTRAHLUNG EMITTED BY β OF PHOSPHORUS-32 IN GOLD. R. Quivy (Institut Interuniversitaire des Sciences Nucléaires, [Brussels]) and J. Franeau. J. phys. radium, 22: 377-84(June 1961). (In French)

Relativistic and non-relativistic theoretical formulas, giving the bremsstrahlung cross section for monoenergetic electrons, are used to compute the bremsstrahlung produced by P-32 β rays in gold. In order to study experimentally this radiation, a method is proposed to interpret experimental spectra obtained with a scintillation counter. Experiments agree satisfactorily with theoretical predictions for thin targets. With thick targets, the intensity of the low-energy radiation increases considerably. The practical use of this bremsstrahlung is discussed. (auth)

31626 INVESTIGATION OF THE γ-RADIATION ACCOMPANYING THE BOMBARDMENT OF THE Mg^{24}, Mg^{25} AND Mg^{26} ISOTOPES WITH THE α-RAYS OF POLONIUM. Eva Csongor (Inst. of Experimental Physics, Debrecen, Hungary). Magyar Fiz. Folyóirat, 8: 357-417(1960). (In Hungarian)

On the basis of literature data it can be stated that the experimental data concerning the γ-radiation induced in Mg isotopes by α-bombardment are insufficient: the excitation states of the intermediate nuclei are not known satisfactorily and the γ-spectrum data are contradictory. In order to clarify these points, the γ-ray spectrum and the excitation function were determined for the 3 electromagnetically separated isotopes. Thin $Mg^{25}O$ and $Mg^{26}O$ targets. equivalent to 1.2 mm air were used. The energy of the α-radiation was controlled by changing the pressure of the slowing-down gas and determining the γ-ray yield. From the resonance energies calculated on the basis of the excitation function the resonance energies and the excited states of the intermediate nuclei Si^{29} and Si^{30} were determined. including 7 previously unknown states for the first and 2 states for the second nucleus. The γ-radiation was found to be much more complex than previously assumed. Bombarding Mg^{24} results in γ-rays corresponding to the $Mg^{24}(\alpha,p)Al^{27}$ reaction. For Mg^{25} 2 superimposed spectra are found corresponding to $Mg^{25}(\alpha,p)Al^{28}$ and $Mg^{25}(\alpha,n)Al$ and for Mg^{26} the $Mg^{26}(\alpha,n)Si^{29}$ reaction was confirmed. A micro-electro-chemical separation of Mg from pyridine was also developed. (TTT)

31627 ENERGY LEVELS AND π BONDING IN POLYNUCLEAR COMPLEXES. C. K. Jørgensen (Cyanamid European Research Inst., Cologny (Geneva), Switzerland) and L. E. Orgel. Mol. Phys., 4: 215-18(May 1961).

The influence of π bonding of nitrogen and oxygen on the energy of the d orbitals of polynuclear iridium and ruthenium complexes was estimated from absorption spectra in the visible region. (auth)

31628 THEORY OF NUCLEAR REACTIONS. I. RESONANT STATES AND COLLISION MATRIX. J. Humblet (Univ. of Copenhagen and California Inst. of Tech., Pasadena) and L. Rosenfeld. Nuclear Phys., 26: 529-78(1961). (In English)

A new formulation of the general theory of nuclear reactions is proposed, on the basis of a definition of the resonant states as decaying states corresponding to complex eigenvalues of the total energy of the compound system. A characterization of these states is derived from "natural" boundary conditions expressing the absence of incoming waves in all channels: such boundary conditions yield in a unified form the bound states, the proper resonant states and "virtual" states of a type familiar from the case of the ^1S state of the deuteron. The dispersion formulae for elements of the collision matrix determining the reaction cross-sections are established, as immediate consequences of their analytical behavior as functions of the complex energy variable, by application of the Mittag-Leffler theorem on the representation of meromorphic functions. The presentation thus obtained, besides being simpler than the usual ones, has over the latter the advantage of eliminating every arbitrary element from the specification of the resonances and of the non-resonant background; these elements of the description are, in particular, independent of the choice of the channel radii, and appear altogether as intrinsic properties of the compound system. (auth)

31629 THEORY OF NUCLEAR REACTIONS. II. THE FOUNDATION OF THE OPTICAL MODEL. L. Rosenfeld (NORDITA, Copenhagen). Nuclear Phys., 26: 579-93(1961). (In English)

An equation determining the optical-model potential in terms of the nuclear interactions is derived from the condition that the model should give the correct shape-elastic scattering, by an argument making direct use of Green's operators, without any expansion in series of orthogonal functions. This method is therefore applicable to the theory in which the resonant states are defined by natural boundary conditions, so that their eigenfunctions are not orthogonal. The computation of the collision matrix for direct interaction processes is performed on the same basis. (auth)

31630 CENTRE-OF-MASS INVARIANCE AND THE ENERGY SHIFT IN THE NUCLEAR DIPOLE STATE. Stavros Fallieros (Bartol Research Foundation, Swarthmore, Penna.). Nuclear Phys., 26: 594-607(1961). (In English)

A relation is obtained between the magnitude of the energy shift in the nuclear dipole state and the particle-shell interaction energy which characterizes the single-particle excitations. It is found that the ratio of these two quantities is approximately independent of the strength, the detailed shape and the odd-state coefficients of the nuclear two-body force. A value of about one-half is obtained for this ratio if the customary values for the even-state nuclear force parameters are used. (auth)

31631 A SEARCH FOR FINE STRUCTURE IN THE REACTIONS $B^{10}(d,\alpha_0)Be_8$ AND $B^{10}(d,\alpha_1)Be^{8*}$. G. J. F. Legge (Univ. of Melbourne). Nuclear Phys., 26: 608-15 (1961). (In English)

The excitation functions for the reactions $B^{10}(d,\alpha_0)Be^8$ and $B^{10}(d,\alpha_1)Be^{8*}$ were measured in 10 kev steps of deuteron energy from 400 to 900 kev. The alpha particles were detected at 45° with a thin CsI(Tl) crystal and photomultiplier. No fine structure is observed in either reaction. The absolute values of the differential reaction cross sections at 45° (laboratory) angle are found to be 0.24 ± 0.05 mb/sr for the ground state group and 1.25 ± 0.4 mb/sr for the group going to the first excited state in Be^8, both cross sections being measured at a deuteron energy of 780 kev. The alpha particle spectrum, as measured with $5\frac{1}{2}\%$ energy resolution and $1\frac{1}{2}\%$ statistics, shows no sign of any Be^8 state between 3 and 5 Mev. (auth)

31632 C^{12} LEVEL STRUCTURE IN THE EXCITATION REGION 20.5–26.5 Mev. G. J. F. Legge and I. F. Bubb (Univ. of Melbourne). Nuclear Phys., 26: 616-33(1961). (In English)

The absolute cross-section for total neutron emission in the reaction $B^{11}(p,n)C^{11}$ was found by an activation technique over the range of proton energies 4.9 to 11.4 Mev. The excitation function for this reaction is plotted in 10 kev steps of proton energy. Eleven resonances are resolved at proton energies of 5.065, 5.48, 6.03, 7.28, 7.73, 8.25, 8.64, 9.24, 9.79, 10.13, and 10.91 Mev. None of the resonances has an estimated width at half height of less than 70 kev. The cross section has a maximum value of 430 ± 45 mb at 6.03 Mev, at which energy the excitation function is fitted by assuming the existence of a single particle state having $J^\pi = 4^-$. Direct interaction and compound system modes of reaction appear to contribute to the cross section roughly in the ratio 2:1 throughout the region of excitation covered. There is some evidence for interference between the two modes. A comparison with other experimental results is made. (auth)

31633 THE DECAY OF Se^{75}. W. F. Edwards and C. J. Gallagher, Jr. (California Inst. of Tech., Pasadena). Nuclear Phys., 26: 649-57(1961). (In English)

Using the DuMond bent-crystal gamma-ray spectrometer, the DuMond iron-free ring-focusing beta-ray spectrometer and an iron free low-field semi-circular spectrometer, the energies and relative intensities of the gamma radiations and of the conversion electrons following the decay of Se^{75}

into As^{75} were measured. The conversion coefficients and transition multipolarities deduced from this information are given and discussed. Comparisons are made with measurements by other investigators. Inconsistencies between reported values of the mixing parameter of the 279.57 kev M1 + E2 transition are reconciled and the best value determined is 0.50 ± 0.06. (auth)

31634 A SIMPLE FORMULA FOR CALCULATION OF THE EFFECTIVE RESONANCE INTEGRAL. W. Oldekop (Siemens-Schuckertwerke A. G., Erlangen, Ger.). Nukleonik, 3: 105-9(July 1961). (In German)

A simple formula was derived which represents all effective resonance integrals measured by Hellstrand satisfactorily. For homogeneous fuel elements a two-term expression is given which depends only on the radius of the fuel element, the concentration of the uranium atoms, the scattering cross section per uranium atom, and the resonance parameters. Two constants dependent only on the resonance parameters were seen as clear parameters and were adaptable to the measurement results in massive metallic uranium rods. It was shown that all usual resonance integrals were largely represented accurately within the measurement accuracy, when the fuel elements concerned are simply homogenized. The theoretical permissibility of the homogenization was discussed. (tr-auth)

31635 DECAY SCHEME OF ^{212}Pb. M. Giannini, D. Prosperi, and S. Sciuti (Centro Studi Nucleari della Casaccia, Rome). Nuovo cimento (10), 21: 430-41 (Aug. 1, 1961). (In English)

Experimental data on the $Pb^{212} \rightarrow Bi^{212}$ decay are reported. The investigation of the Pb^{212} decay scheme is of interest because of shell model considerations. Coincidence spectra and γ, γ angular correlations are employed to measure the intensities of weakest transitions, and to make spin assignments. A decay scheme is proposed. Further, the existence of a 177 kev γ ray is demonstrated. (auth)

31636 DELAYED ALPHA PARTICLES FROM ^{16}N. R. E. Segel, J. W. Olness, and E. L. Sprenkel (Aeronautical Research Lab., Dayton, Ohio). Phil. Mag. (8), 6: 163-5 (Jan. 1961).

The alpha particle spectrum resulting from the decay of N^{16} was measured to obtain information pertaining to the decay through the 8.88-, 9.58-, and 9.84-Mev states in O^{16}. N^{16} was prepared by bombarding nitrogen gas enriched to 96% N^{15} with 2-Mev deuterons. The decay spectra showed only one alpha particle group, a broad group centered at about 1.72 Mev. This group was identified with the broad state centered at 9.58 Mev. (M.C.G.)

31637 BETA-DECAY OF ^{16}N: CONSERVATION OF SPIN AND PARITY IN ^{16}O. D. E. Alburger (Brookhaven National Lab., Upton, N. Y.) R. E. Pixley, D. H. Wilkinson, and P. Donovan. Phil. Mag. (8), 6: 171-4(Jan. 1961).

The degree to which parity is conserved in strong interactions was studied and F^2, the intensity of the component of irregular parity in a typical nuclear wave function, was determined. A thick target of TiN^{15} was irradiated with a beam of deuterons at 1.1 Mev. The consequent N^{16} decay was examined. It was found that alpha particles are emitted following the beta decay of N^{16}. These alpha particles came from the decay of the broad 1- state in O^{16}. Results suggested a value of 7×10^{-12} for F^2. (M.C.G.)

31638 ON THE EDWARDS-MATTHEWS APPROACH TO π-N SCATTERING. Hong-Mo Chan (The University, Birmingham, Eng.). Phil. Mag. (8), 6: 201-8(Feb. 1961).

In an attempt to extend the Edwards-Matthews (1957 a) theory of $\pi-N$ scattering to higher relativistic energy it was discovered that their evaluation of the fourth-order Feynman graphs required was incorrect, involving an expansion which fails to converge at the threshold of physical scattering energy. A new evaluation of these graphs was carried through and the result substituted into their scattering formula. The new values did not show the agreement with experiment found in Edwards and Matthews' original results. A study of the Feynman graphs and the method of their evaluation are briefly described. (auth)

31639 THE STABILITY OF A WAVEFUNCTION UNDER A PERTURBATION. G. G. Hall (Imperial Coll. of Science and Tech., London). Phil. Mag. (8), 6: 249-58 (Feb. 1961).

The concept of the stability of a wave function under a perturbation is defined and the properties which distinguish stable wave functions are deduced. The stability of approximate wave functions is particularly examined and a number of general results stated. Self-consistent wave functions are shown to be stable under one-electron perturbations. The concept enables hitherto isolated results to be unified and extended. In particular a method of calculating nuclear magnetic shielding constants for atoms is given. The concept also suggests means of improving an approximate wave function so that the derived estimate of some property is made more accurate. (auth)

31640 HAMMER TRACKS FROM THE PHOTODISINTEGRATION OF LIGHT EMULSION NUCLEI. W. T. Morton and T. G. Walker (Univ. of Glasgow). Phil. Mag. (8), 6: 311-12(Feb. 1961).

A search was made for hammer tracks, Li^8 or B^8 decaying into two alpha particles through an excited state of Be^8, originating in the photodisintegration of the light nuclei, C, N, and O, of nuclear emulsions. Ilford C2 nuclear emulsions were exposed perpendicular to a bremsstrahlung beam of 120-Mev maximum energy. Eight hammer tracks were identified. The cross section for the photoproduction of Li^8 from C^{12} was found to be $(4.9 \pm 2.0) \times 10^{-30}$ cm^2. (M.C.G.)

31641 TOTAL CROSS SECTION OF LEAD FOR SLOW NEUTRONS. M. F. Collins and G. Dolling (Cavendish Lab., Cambridge, Eng.). Phil. Mag. (8), 6: 485-9(Apr. 1961).

A beam of filtered neutrons with a mean wavelength of 8.4 Å was used to measure the total cross section of lead as a function of temperature from 290 to 840°K. The cross section was found to vary linearly with temperature in both solid and liquid phases to within 1°K of the melting point. There was a jump in cross section at the melting point of (9.4 ± 0.6)%. The results in the solid were not in agreement with predictions based on the Debye theory. (auth)

31642 THE HALF-LIFE OF VANADIUM-50. A. McNair (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Phil. Mag. (8), 6: 559-61(Apr. 1961).

The half life of the naturally occurring odd-odd isotope V^{50} for electron capture decay to the first excited state of Ti^{50} was found to exceed 8×10^{15} years and for negatron decay to the first excited state of Cr^{50} to exceed 1.2×10^{16} years. (auth)

31643 THE HALF-LIFE OF RUBIDIUM-87. A. McNair and H. W. Wilson (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Phil. Mag. (8), 6: 563-72(Apr. 1961).

A 4π proportional counter system capable of examining thin sources of extended area was used to determine the half life of Rb^{87}, which was found to be $(5.25 \pm 0.10) \times 10^{10}$

years. Corrections for absorption of electrons and for scattering in the source and in the source supporting foil are discussed. (auth)

31644 THE DEVELOPMENT OF CASCADES INITIATED BY NUCLEAR INTERACTION. K. Pinkau (Univ. of Bristol, Eng.). Phil. Mag. (8), 6: 657-67(May 1961).

The distribution function describing the development of electromagnetic cascades was derived under the assumption that the primary particles are γ rays with a certain energy spectrum and angular spread. By comparing experimental results on the lateral distribution of electrons in cascades initiated by nuclear interactions with the calculations presented one may obtain information on some characteristic features of "jets." At large distances from the cascade "core," the electron distribution is identical with that derived from ordinary cascade theory, thus indicating that the angular spread of the primary γ rays can then be neglected. This result is of interest when measurements in large air showers are compared with theory. (auth)

31645 THE LOW ENERGY ION BOMBARDMENT OF GOLD. D. G. Brandon and Piers Bowden (Univ. of Cambridge, Eng.). Phil. Mag. (8), 6: 707-10(May 1961).

An investigation was made of the sub-surface damage produced in crystal lattices by radiation. Thin films of gold were bombarded with argon ions. The total dose delivered to each specimen was 3.5×10^{17} ions/cm^2 in two hours. The effects produced by a particular bombardment were found to be dependent on orientation and temperature. For a grain in the foil bombardment at 22°C, the efficiency of point-defect production was estimated to be of the order of 5×10^{-4} point defects retained per incident ion. (M.C.G.)

31646 INTERMEDIARY EFFECTS IN NUCLEAR BETA DECAY. J. D. Childress (Brandeis Univ., Waltham, Mass.). Phys. Rev., 123: 1729-34(Sept. 1, 1961).

Two intermediate meson theories, the vector meson theory and the scalar meson theory, of weak interactions are analyzed for nonlocal effects in nuclear beta-decay processes. The principal effects are the introduction of a nonlinearity in the Kurie plot in both meson theories and the alteration of the electron-neutrino angular correlation in the vector meson theory only. These effects are shown to be quite small, of the order of 0.1% in the most favorable cases, for the lower mass limits imposed on the mesons by the requirement of compatibility with present experimental data. The magnitude of these effects is considered to be on the threshold, at least, of measurability. Both meson theories produce effective nuclear beta-decay coupling constants that differ in the order of a per cent from the effective constants in muon decay. (auth)

31647 DELAYED-NEUTRON STUDIES FROM THE THERMAL-NEUTRON-INDUCED FISSION OF Pu^{241}. Samson A. Cox (Argonne National Lab., Ill.). Phys. Rev., 123: 1735-7(Sept. 1, 1961).

The delayed-neutron activity resulting from the thermal-neutron-induced fission of Pu^{241} was studied. The measured total delayed-neutron yield, determined from a comparison measurement between Pu^{241} and U^{235}, is 0.0154 ± 0.0015 neutron/fission. The measured values for the individual group yields and the associated half-lives are: 0.000154 ± 0.00004 n/f, 54.0 ± 1 sec; 0.00365 ± 0.0001 n/f, 23.2 ± 0.5 sec; 0.00275 ± 0.0004 n/f, 5.6 ± 0.6 sec; 0.0062 ± 0.0008 n/f, 1.97 ± 0.1 sec; 0.0029 ± 0.0003 n/f, 0.43 ± 0.04 sec. The systematic behavior of delayed-neutron emission is discussed. The systematic study suggests that the variation of delayed-neutron yield with both mass number and atomic number is influenced more by changes in the fission-product charge distribution than by changes in the fission-product mass distribution. (auth)

31648 (n,d) AND (n,p) REACTIONS NEAR Z = 50. R. A. Peck, Jr. (Brown Univ., Providence). Phys. Rev., 123: 1738-46(Sept. 1, 1961).

An emulsion study is reported of charged particles produced by 14-Mev neutron bombardment of Rh^{103}, In^{115}, Sn^{116}, Sn^{120}, Sb, and Te. For all but Te (no detectable yield) cross sections and spectra are presented, with distributions over the first 40° of laboratory angle of energy groups from Rh, In, and Sb. Contrary to an assumption common in earlier work, there is strong evidence that the (n,d) reaction contributes strongly. Five peaks among the Rh, In, and Sb spectra are identified with pickup transitions, the angular distributions conforming to Butler curves for uniquely predicted (2) or reasonable (3) l values. These values are consistent with target proton orbitals in all five cases. The wide (n,np) group is found at the expected energy in the Rh, In, Sn^{116}, and Sb spectra; its angular distribution is anomalous for Rh but displays the expected isotropy in the other three cases. Up to at least 6-Mev excitation the (n,p) gross structure is dominated by single-particle effects, the uncontaminated (n,p) yield obeying predictions of the Nilsson model as to spectral concentration and angular distribution; the low collective levels excited in (p,p′) are not observed. Systematic behavior of the direct-interaction radius for (n,d) and (n,p) and of the reduced width for pickup are found to be reasonable. It is inferred that the parent state for proton pickup with low residual excitation is almost purely a single-particle state in the case of Sb, and has a strong single-particle character in Rh and a very weak one in In. (auth)

31649 3.1-HOUR Y^{90m}. W. S. Lyon, J. S. Eldridge, and L. C. Bate (Oak Ridge National Lab., Tenn.). Phys. Rev., 123: 1747-9(Sept. 1, 1961).

A 3.1-hr isomer, Y^{90m}, was produced by neutron capture in yttrium. The isomeric transition consists of two coincident gamma rays of nearly equal intensity and energies, 203 kev and 480 kev. Mass and atomic number assignment was made by cross bombardment and chemical separations. Modes of production were $Y^{89}(n,\gamma)Y^{90m}$ (thermal and epicadmium neutrons) and $Nb^{93}(n,\alpha)Y^{90m}$, and $Zr^{90}(n,p)Y^{90m}$ (14-Mev neutrons). (auth)

31650 10-MEV PROTON REACTION CROSS SECTIONS COMPARED WITH SURFACE AND VOLUME ABSORPTION OPTICAL MODELS OF THE NUCLEUS. Richard D. Albert and Luisa F. Hansen (Univ. of California, Livermore). Phys. Rev., 123: 1749-50(Sept. 1, 1961). (UCRL-6427)

The (p,n) cross sections were measured at 9.85 Mev for self-supporting thin targets of Al, Ti, Fe, Co, Ni, Cu^{63}, Cu^{65}, Rh, Ag, Sn, Ta, and Au. The (p,2n) contributions were calculated using the statistical model of the nucleus for Rh, Ta, Ag, and Au. Charged-particle emission was assumed negligible in Ta and Au because of small Coulomb penetrabilities. Approximate proton reaction cross sections were obtained by adding (p,n) and (p,2n) cross sections to (p,p′) and (p, α) cross sections previously reported by Meyer and Hintz. These results were compared with volume absorption and surface absorption optical-model calculations of proton reaction cross sections. The parameters for both model calculations were obtained prior to this work by fitting proton elastic scattering and polarization data. The results indicate a surface-absorption potential rather than a volume-absorption potential. (auth)

31651 HALF-LIVES OF SOME NUCLEAR STATES IN THE MILLIMICROSECOND REGION. T. D. Nainan (Indi-

ana Univ., Bloomington). Phys. Rev., 123: 1751-7(Sept. 1, 1961).

A time-to-pulse height converter, fast coincidence arrangement, and multichannel analyzer were used to measure half-lives of some nuclear states in the millimicrosecond range. The half-lives of the following nuclear states were measured: the 325-kev level in V^{51}, $(2.80 \pm 0.04) \times 10^{-10}$ sec; the 555-kev level in Mn^{52}, $(1.85 \pm 0.07) \times 10^{-9}$ sec; the 1490-kev level in Co^{57}, $(1.00 \pm 0.05) \times 10^{-9}$ sec; the 245-kev level in Se^{77}, $(1.30 \pm 0.08) \times 10^{-9}$ sec; the 155-kev level in Sb^{119}, $(0.83 \pm 0.2) \times 10^{-9}$ sec; the 123-kev level in Cs^{131}, $(4.15 \pm 0.08) \times 10^{-9}$ sec; and the 103-kev level in Eu^{153}, $(3.8 \pm 0.02) \times 10^{-9}$ sec. The well-known level of Ta^{181} at 48 kev gives $(1.10 \pm 0.02) \times 10^{-8}$ sec and that of Gd^{154} at 122 kev, 1.15×10^{-9} sec. A comparison with the results given by theory is made. (auth)

31652 NUCLEAR LEVELS IN A NUMBER OF EVEN-EVEN RARE EARTHS ($150 \leq A \leq 184$). B. Harmatz (Oak Ridge National Lab., Tenn.), T. H. Handley, and J. W. Mihelich. Phys. Rev., 123: 1758-86(Sept. 1, 1961).

To obtain more data on the system of levels in even-even nuclei, a number of such nuclei ($150 \leq A \leq 184$) were studied with electron-capturing sources in permanent magnet spectrographs. Some measurements were made with scintillation counters. Data confirming recently reported results on the decay of Tb^{152}, Tb^{156}, and Ho^{162} have been obtained. It was found that Eu^{150} has two isomeric states ($T_{1/2}$ = 14 hr and >5 yr). Levels at 740.7 (0+) and 773.3 (4+) kev in Sm^{150} are proposed. A study of the two isomeric activities of Tb^{154} indicated the existence of levels in Gd^{154} which may be described as a gamma-vibrational band (at 997.3 kev) and a beta-vibrational band (at 680.6 kev). The new data for Tm^{166} (7.7 hr) are consistent with levels in Er^{166} at 2137.3 and 2164.6 kev, both of which are probably 3 states and which exhibit considerably different branching ratios of the de-exciting transitions. The decay of Lu^{172} appears to populate a large number of even-parity levels in Yb^{172} which may be arranged in rotational bands corresponding to primary or base states at 1174.0 kev (I = 3+), 1467.5 kev (I = 2+), 1664.3 kev (I = 3+), 1702.1 kev (I = 3+), 2075.0 kev (I = 4+), and 2287.3 kev (I = 4+). The very complex decay of the two isomers of Re^{182} excite many odd-parity levels which may be arranged in seven or more bands. In addition, even-parity beta- and gamma-vibrational bands may be populated. Electron-capture decay of Re^{184} populates a gamma-vibrational band in W^{184} of spins 2, 3, and 4. Data relevant to the rotational energy parameters and ratios of gamma-ray transition probabilities from the various states are presented. As a corollary, data on the decay of Eu^{149} are presented since this activity was present in some composite sources. (auth)

31653 TEST OF THE ξ-APPROXIMATION IN SOME FIRST-FORBIDDEN $2^- \rightarrow 2^+$ β-TRANSITIONS. R. M. Steffen (Purdue Univ., Lafayette, Ind.). Phys. Rev., 123: 1787-93(Sept. 1, 1961).

The β-γ directional correlations of the first-forbidden nonunique $2^- \rightarrow 2^+$ β transitions of K^{42}, Sb^{122}, and Au^{198} were investigated and compared with the predictions of the ξ approximation, whose range of applicability is discussed. Upper limits for the contribution of the tensor-type matrix element $\int B_{ij}$ to the β transitions were estimated on the basis of the modified B_{ij} approximation. The anisotropy coefficient $A_2(W)$ in the β-γ directional correlation involving the 1.98-Mev β transition of K^{42} varies from $A_2(1.66) = -0.009 \pm 0.002$ to $A_2(4.60) = -0.049 \pm 0.002$, where W is in units of mc^2. The energy dependence of $A_2(W)$ deviates from the predictions of the ξ approximation by about 40% over the measured energy range. A rough estimate of the upper limit for the contribution from the B_{ij} component is: $|C_A \int B_{ij}| < 0.3(|V_0| + |Y_1|)$ (in the notation of Kotani). The anisotropy factor $A_2(W)$ of the β-γ directional correlation involving the 1.40-Mev β transition of Sb^{122} varies from $A_2(1.96) = +0.035 \pm 0.003$ to $A_2(3.5) = +0.081 \pm 0.004$. The energy dependence of $A_2(W)$ is well represented by the factor $\lambda_2(Z,W)$ $(W^2-1)/W$ as predicted by the ξ approximation. The upper limit of the $\int B_{ij}$ contribution to this β transition is estimated as: $|C_A \int B_{ij}| < 0.15|Y_1|$ or $|C_A \int B_{ij}| < 0.2|V_0|$. The anisotropy factor $A_2(W)$ of the Au^{198} β-γ directional correlation involving the 0.96-Mev β transition varies between $A_2(1.39) = +0.0076 \pm 0.0010$ and $A_2(2.78) = +0.0286 \pm 0.0010$, and its energy dependence agrees very well with the predictions of the ξ approximation. The upper limit for the $\int B_{ij}$ matrix element is estimated as: $|C_A \int B_{ij}| < 0.1|Y_1|$. (auth)

31654 MAGNETIC MOMENTS OF 69-MIN Ag^{104} AND 27-MIN Ag^{104m}. O. Ames, A. M. Bernstein, M. H. Brennan, and D. R. Hamilton (Princeton Univ., N. J.). Phys. Rev., 123: 1793-1800(Sept. 1, 1961). (PUC-1961-28)

The hyperfine structure separations of 69-min Ag^{104} and of 27-min Ag^{104m} were measured using the atomic beam magnetic resonance method. The results are: $\Delta\nu_{I=5}$(69-min Ag^{104}) $= 33{,}500^{+2000}_{-1000}$ Mc/sec, $\Delta\nu_{I=2}$(27-min Ag^{104m}) = 35,000 ± 2000 Mc/sec. The sign of the nuclear magnetic dipole moment was found to be positive for both states, and by use of the Fermi-Segrè formula one obtains $\mu_I(I = 5) = +4.0^{+0.2}_{-0.1}$ nm, $\mu_I(I = 2) = +3.7 \pm 0.2$ nm. Nuclear configurations which give these moments are discussed and comment is given on the difference between Ag^{104} which shows a 2^+, 5^+ angular momentum recoupling doublet and Ag^{106} and Ag^{110} which show a 1^+, 6^+ doublet. (auth)

31655 NUCLEAR ORIENTATION OF Nd^{147}. G. A. Westenbarger and D. A. Shirley (Univ. of California, Berkeley). Phys. Rev., 123: 1812-18(Sept. 1, 1961). (UCRL-9562)

Nd^{147} was aligned and polarized at low temperatures in a neodymium ethylsulfate lattice. A saturation correction for susceptibility was verified. The effect of nondiagonal interactions on nuclear orientation was illustrated. Spin assignments of 5/2+, 3/2+, 5/2+, and 5/2+ were made for the excited states of Pm^{147} at 91, 410, 531, and 686 kev, respectively. Mixing ratios were obtained for six mixed γ rays in Pm^{147}. The magnitude of the amplitude mixing ratio δ(E2/M1) M1) was found to be approximately proportional to γ-ray energy. Evidence was obtained that the β branches with end points at 0.23, 0.38, and 0.81 Mev are mostly of the L = 0 type. (auth)

31656 PROTON INTERACTIONS WITH Cu^{63} AND Cu^{65}. J. Benveniste, R. Booth, and A. Mitchell (Univ. of California, Livermore). Phys. Rev., 123: 1818-23(Sept. 1, 1961). (UCRL-6296)

Elastic scattering of protons from Cu^{63} and Cu^{65} was observed for several energies in the range 7 to 12 Mev. When plotted as the ratio-to-Rutherford, the isotopic differential cross sections exhibit a shift which is two to three times larger than would be expected if the nuclear radius were governed by the $A^{1/3}$ law. Inelastic scattering and (p,α) cross sections were measured to contribute to the knowledge of the reaction cross sections and to an unambiguous optical-model analysis. (auth)

31657 BETA-DECAY MATRIX ELEMENTS IN Sb^{122}. G. E. Bradley, F. M. Pipkin, and R. E. Simpson (Harvard Univ., Cambridge, Mass.). Phys. Rev., 123: 1824-34 (Sept. 1, 1961).

Dynamic nuclear orientation was used to study the $2^- \rightarrow 2^+$ 1.42-Mev beta ray in the decay of Sb^{122}. The Sb^{122}, which was a substitutional donor atom in a silicon crystal, was oriented by saturating each of the four $\Delta(m_I + m_J) = 0$ forbidden transitions. The angular distribution of the gamma ray following the beta ray was measured with two scintillation counters. The nuclear and electron relaxation times were determined by the rate of growth and decay of the nuclear orientation. The electron ($\Delta m_J = \pm 1$, $\Delta m_I = 0$) relaxation time was (4.9 ± 1.2) min. The nuclear relaxation can be represented as due to a combination of the modulation of the isotropic hyperfine interaction and nuclear quadrupole relaxation. For the dipole mechanism, 50 min $\leq T_N \leq$ 100 min and for the quadrupole mechanism, 150 min $\leq T_N \leq$ 1700 min. An analog computer was used to correct the initial orientation parameters for the effects of nuclear relaxation. From these, data restrictions can be placed upon the relative amounts of angular momentum carried off by the 1.42-Mev β ray. The modified B_{ij} approximation was then used to analyze this result in conjunction with the beta-gamma angular correlation. There are three sets of matrix elements which can explain the observed data. One set implies that all the antimony atoms are in the simple donor sites; the other two sets imply that only 40% of the antimony atoms are in the donor sites. The first set gives V = −0.5 ± 0.1, Y = −0.5 ± 0.1; the second set, V = −4.2 ± 2.0, Y = −1.4 ± 0.5; the third set, V = −6.3 ± 1.0, Y = +1.8 ± 1.5. (auth)

31658 5-BEV NEUTRON CROSS SECTIONS IN HYDROGEN AND OTHER ELEMENTS. John H. Atkinson, Wilmot N. Hess, Victor Perez-Mendez, and Roger Wallace (Univ. of California, Berkeley). Phys. Rev., 123: 1850-9(Sept. 1, 1961). (UCRL-8966(Rev.)).

Neutron total and reaction cross sections at 5.0 Bev were measured. Transmission measurements were made in good and poor geometry. The high-energy neutron beam was produced when the Bevatron circulating proton beam struck a copper target. Neutrons were identified by their production of pions in a beryllium block. The pions were then detected by a counter telescope including a gas Čerenkov counter. The threshold of this gas Čerenkov counter defined the mean effective neutron energy at 5.0 ± 0.4 Bev, with the half-intensity points of the neutron energy distribution at 5.9 and 4.2 Bev. The cross sections measured for the various elements are given in tabular form. The 5-Bev total cross sections are 20% below the total cross-sections measured at 1.4 Bev by Coor et al., whereas the reaction cross sections remain essentially constant as a function of energy above 300 Mev. This behavior of the cross sections can be interpreted by a generalized diffraction theory developed by Glassgold and Grieder. (auth)

31659 APPLICATION OF NUCLEON-NUCLEON DISPERSION RELATIONS TO NUCLEAR MANY-BODY PROBLEM. I. Hamamoto (Univ. of Tokyo) and H. Miyazawa. Phys. Rev., 123: 1860-4(Sept. 1, 1961).

A method is given of obtaining the nucleon-nucleon scattering amplitude within nuclear matter, when the nucleon-nucleon dispersion relations are known. This is attained by establishing the dispersion relation for the scattering amplitude under the influence of the Pauli exclusion principle in intermediate states. With this modified amplitude the binding energy of the nucleus is calculated using Brueckner's method. The binding energy per nucleon turned out to be −13.2 Mev, if the contribution of the three-pion exchange potential is adjusted to give the correct nuclear density. The implication of these results is discussed. (auth)

31660 ENERGY TRANSFER WITHIN A SPIN SYSTEM. D. F. Holcomb, B. Pedersen, and T. R. Sliker (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 123: 1951-7(Sept. 15, 1961).

The nature of the transfer, within a single nuclear spin system, of energy absorbed from an external source of radio-frequency magnetic field was investigated by a double-irradiation technique. Energy from a high-power oscillator running at fixed frequency is absorbed by the nuclear spin system. The frequency of a second, low-level oscillator is then swept through the nuclear resonance, sampling the line shape existing in the presence of the strong rf field from the fixed-frequency oscillator. Particular spin systems investigated were the proton system in single crystalline $CaSO_4 \cdot 2H_2O$, and the Al^{27} system in aluminum metal. In aluminum, the technique gives direct experimental verification of a completely homogeneous saturation behavior, a behavior expected from elementary considerations. It also gives further verification of the Redfield saturation theory. In $CaSO_4 \cdot 2H_2O$, an enhancement effect is observed which allows one to determine the importance of double-flip spin-lattice relaxation processes. The technique could be usefully applied to many spin systems to determine the degree of inhomogeneity in the resonance line broadening. (auth)

31661 NUCLEAR QUADRUPOLE INTERACTION IN PURE METALS. T. P. Das (Columbia Univ., New York) and M. Pomerantz. Phys. Rev., 123: 2070-6(Sept. 15, 1961).

Calculations of the ionic part of the electric field gradient at the nuclei of certain metals are combined with available experimental data to obtain information about the electronic structures of the metals, or estimates of nuclear quadrupole moments. The metals considered are Be, Sc, Re, La, Mg, Co, Zn, and Cd, which have the hexagonal close-packed structure, and indium, which has a centered tetragonal structure. Some comparison is made with other information about the shapes of the Fermi surfaces and a pertinent experiment on Zn is suggested. (auth)

31662 SPECTRA INDUCED BY 200-kev PROTON IMPACT ON NITROGEN. R. H. Hughes (Univ. of Arkansas, Fayetteville), J. L. Philpot, and C. Y. Fan. Phys. Rev., 123: 2084-6(Sept. 15, 1961).

Spectra induced by 200-kev proton impact on nitrogen were observed in the spectral region from 3000 to 6000 A. The principal feature was the strong excitation of the N_2^+ first negative band systems. Absolute cross sections for excitation were determined for the principal bands of this system as well as for two NII atomic lines. A relatively weak Doppler-shifted H_β line was detected, and the cross section for the charge-exchange electron-capture into the n = 4 excited state of hydrogen was estimated. Second positive N_2 bands were observed at higher pressures. (auth)

31663 ABSOLUTE MEASUREMENT OF A SET OF ENERGY CALIBRATION STANDARDS. E. H. Beckner (Rice Univ., Houston, Tex.), R. L. Bramblett, G. C. Phillips, and T. A. Eastwood. Phys. Rev., 123: 2100-9(Sept. 15, 1961).

A 180° magnetic spectrometer was employed to measure the energy of several neutron thresholds and γ-ray resonances, as well as the energy of the alpha particles emitted by Po^{210}. The primary reason for performing these experiments was to obtain a set of energy standards with consistent experimental techniques for all the measurements. The neutron thresholds studied were $Li^7(p,n)Be^7$, $B^{11}(p,n)C^{11}$, $C^{13}(p,n)N^{13}$, and $F^{19}(p,n)Ne^{19}$. The γ-ray resonances at 872 kev in $F^{19}(p,\alpha\gamma)O^{16}$ and at 992 kev in $Al^{27}(p,\gamma)Si^{28}$ were observed. The same instrument used to make the energy

measurements for these experiments was also employed to determine the energy of the alpha particles emitted by Po^{210}. (auth)

31664 ISOTOPE SHIFT IN AXIALLY ASYMMETRIC NUCLEI. M. L. Rustgi (National Research Council, Ottawa and Harvard Univ., Cambridge, Mass.). Phys. Rev., 123: 2110-11(Sept. 15, 1961).

The effect of axial asymmetry on isotope shift, as introduced in the theory of Davydov and Filippov, is investigated and is found to be non-negligible. An accurate experimental study of the isotope shift may therefore provide evidence in favor of or against Davydov-Filippov's theory for deformed nuclei. (auth)

31665 FISSION OF URANIUM-238 WITH CARBON IONS. T. Sikkeland, A. E. Larsh, and G. E. Gordon (Univ. of California, Berkeley). Phys. Rev., 123: 2112-22(Sept. 15, 1961). (UCRL-9540)

Angular distributions and kinetic-energy spectra of fragments, and cross sections for fission of U^{238} with 63- to 124-Mev C^{12} ions, were measured with the use of a silicon p-n junction detector. The distributions were analyzed in terms of the formation of a compound nucleus and subsequent decay by evaporation of neutrons in competition with fission. The percent fission from each isotope in the evaporation chain was calculated and the over-all angular distribution estimated with the use of the theoretical curves of Halpern and Strutinski. At the highest bombarding energies, the observed angular distributions were found to be more nearly isotropic than predicted. The mean linear momentum of the fissioning nucleus appears to be less than that of the heavy ion. A possible explanation for these discrepancies is that before the fission event there is competition from reactions in which particles are emitted in the forward direction. The contribution from this kind of reaction is estimated to be of the order of 30% at 95 and 124 Mev. Over the entire range of bombarding energies, the most probable total kinetic energy release is 186 ± 6 Mev. By correspondence this suggests that the fissioning nuclei are californium isotopes. The fission cross section increases from a value of 40 mb at 63 Mev to 2.4b at 124 Mev. The experimental fission cross sections agree well with the cross sections for compound-nucleus formation calculated by use of a square-well nuclear potential with a radius parameter $r_0 = 1.5 \times 10^{-13}$ cm. (auth)

31666 STUDIES OF STRIPPING AND PICKUP REACTIONS ON THE BASIS OF THE PAIRING PLUS QUADRUPOLE-QUADRUPOLE INTERACTION MODEL. Shiro Yoshida (Univ. of Pittsburgh). Phys. Rev., 123: 2122-30 (Sept. 15, 1961).

Cross sections for (d,p) and (d,t) reactions in units of the single-particle cross sections (the spectroscopic factors) are calculated for spherical nuclei. It is assumed that the protons fill a closed shell and that only neutrons in an unfilled shell interact with each other through the pairing and quadrupole-quadrupole interactions. First the pairing interactions problem is solved by introducing quasi-particles according to Belyaev. Next the quadrupole-quadrupole interaction is diagonalized, taking into account two quasi-particle states for the first excited state of even-even nuclei. Using these wave functions the spectroscopic factors are obtained in simple form, and are evaluated numerically for the case of the Sn isotopes. Comparison is made with experiments for the transitions to the ground states of even-even and even-odd isotopes as well as to the vibrational states of even-even isotopes. Agreement in both cases is fairly good. (auth)

31667 DECAY OF $Rh^{102} \rightarrow Ru^{102}$. F. K. McGowan and P. H. Stelson (Oak Ridge National Lab., Tenn.). Phys. Rev., 123: 2131-9(Sept. 15, 1961).

Singles and coincident spectra of gamma rays from decay of Rh^{102} produced by the (p,n) reaction on ruthenium containing 97.2% Ru^{102} were measured with scintillation spectrometers. The energies (in kev) of the gamma rays are: 415 ± 4, 475 ± 5, 630 ± 6, 695 ± 7, 745 ± 8, 765 ± 8, 1050 ± 10, 1105 ± 8, 1110 ± 11, 1365 ± 10, 1565 ± 13, 1795 ± 15, 2040 ± 14, and 511 (annihilation gamma rays). Spins of the levels in Ru^{102} consistent with the directional angular correlations of gamma-ray cascades are: 475(2+), 1105(2+ and 4+, doublet), 1525(3), 1840(0+), 1870(3, 4, 5, or 6), 2040(2+), 2220(3), and 2270(?). A value of E2/M1 ≥ 225 for the 630-kev transition (2+ → 2+) was deduced from the composite correlation of the 630−475 kev cascades. The branching ratio of cascade to crossover transitions from the decay of the second 2+ state is 1.5 ± 0.3. The intensity of the annihilation gamma rays decays with a half-life of 205 ± 10 days. Gamma-ray spectra were measured as a function of time for 920 days and a change in the relative population of the states is observed. From this the existence of a long-lived isomeric state in Rh^{102} is inferred. (auth)

31668 PROMPT FISSION NEUTRON SPECTRUM OF Pu^{241}. A. B. Smith (Argonne National Lab., Ill.), R. K. Sjoblom, and J. H. Roberts. Phys. Rev., 123: 2140-2 (Sept. 15, 1961).

The energy distribution of prompt neutrons resulting from the thermal-neutron-induced fission of Pu^{241} is measured. Fast time-of-flight techniques are employed in the neutron energy range 0.3 to 6.0 Mev. Proton recoils in emulsions are utilized for the measurement of neutron energies from 1.6 to 7.0 Mev. The experimentally determined Pu^{241} fission neutron spectrum is well represented by the Maxwellian distribution, $N(E) \propto E^{\frac{1}{2}} e^{-E/T}$, where E is the neutron energy in Mev, N(E) the number of neutrons per unit energy interval, and T = 1.335 ± 0.034 Mev. The measured average Pu^{241} fission neutron energy is 2.002 ± 0.051 Mev. (auth)

31669 NUCLEAR MAGNETIC MOMENT RATIO AND LINEWIDTHS OF N^{14} AND N^{15}. H. R. Brooker, P. J. Haigh, and T. A. Scott (Univ. of Florida, Gainesville). Phys. Rev., 123: 2143-5(Sept. 15, 1961).

The ratio of the nuclear magnetic moment of N^{14} to that of N^{15} in liquid nitrogen was measured using the technique of nuclear magnetic resonance. The value obtained is $\mu(14)/\mu(15) = 1.4257641 \pm 0.0000010$. The true linewidths (between points of maximum slope) were determined to be 24 ± 4 cps for N^{14} and < 4 cps for N^{15}. (auth)

31670 STRIPPING ANALYSIS OF THE $Be^9(Li^6,\alpha)B^{11}$ REACTION. J. J. Leigh (Univ. of Minnesota, Minneapolis). Phys. Rev., 123: 2145-8(Sept. 15, 1961).

An analysis of the angular distributions of α particles from the $Be^9(Li^6,\alpha)B^{11}$ reactions was carried out using a simple "lump" stripping model. Both the normal stripping mode and "heavy-particle stripping" were incorporated. The model assumes that the Li^6 and the Be^9 nuclei may be represented by the two-cluster configurations "alpha particle plus deuteron" and "alpha particle plus He^5", respectively. The angular distribution calculated for the first excited state reaction provides a satisfactory fit to previously published experimental results at a laboratory bombarding energy of 3.25 Mev. The theoretical angular distribution for the ground state reaction is less successful but does show the principle features of the experimentally observed angular distribution. (auth)

31671 GAMMA-GAMMA DIRECTIONAL CORRELATION IN Mg^{24}. D. W. Glasgow and Larry Schecter (Oregon State Univ., Corvallis). Phys. Rev., 123: 2149-50(Sept. 15, 1961).

The directional correlation between the 1.368-Mev gamma ray and the 2.75-Mev gamma ray of Mg^{24} was measured in an effort to strengthen the spin and parity assignment of the 4.12-Mev state. The data yield a least-squares solid-angle-corrected correlation function $W(\theta) = 1 + (0.102 \pm 0.003)P_2(\cos\theta) + (0.009 \pm 0.005) \times P_4(\cos\theta)$. This is consistent with the assignment (4+) for the 4.12-Mev state and analysis indicates that there can be at most 0.003% M3 radiation mixed with pure E2 radiation in the 2.75-Mev gamma ray transition. (auth)

31672 PHOTODISINTEGRATION OF Be^9. J. S. Blair (Univ. of Washington, Seattle). Phys. Rev., 123: 2151-3 (Sept. 15, 1961).

The reaction $Be^9(\gamma,n)Be^8$ is discussed for those transitions in which the odd neutron goes from an initial p state, assumed to be strongly coupled to a deformed Be^8 core, to an s state in the continuum. The relation between this strong-coupling model and the single-nucleon calculations of Francis, Goldman, and Guth is given. The model is applied to experiments recently reported by Jakobson, and accounts for the observed increase in cross section observed at an excitation energy of 4.6 Mev, the isotropic distribution of the neutrons associated with this rise, and the ratio of the integrated cross section for this rise to that for the threshold peak. (auth)

31673 INTEGRATED CROSS SECTION FOR A VELOCITY-DEPENDENT POTENTIAL. O. Rojo and J. S. Levinger (Louisiana State Univ., Baton Rouge). Phys. Rev., 123: 2177-9(Sept. 15, 1961).

For a possible distinction between a velocity-dependent two-nucleon potential, and a static potential with an infinite repulsive core, their contributions to the integrated cross section (σ_{int}) for the deuteron photoeffect were studied. Both potentials considered are central, with square shapes, and have Serber mixtures for the attractive parts. (They have Wigner character for the repulsive core, and for the velocity-dependent term, respectively.) These potentials are adjusted to give the observed binding energy of the deuteron, the same effective range $\rho(-\epsilon, -\epsilon) = 1.76$ fermis; and the same value (260 Mev) at which the ^3S phase shift changes sign. Using sum-rule calculations, in the electric-dipole approximation, it is found that σ_{int} for the static case is 37.7 Mev-mb, while for the velocity-dependent case it is very nearly the same: namely, 38.8 Mev-mb. (auth)

31674 FRAGMENTATION PROCESSES IN HIGH ENERGY PARTICLE REACTIONS WITH NUCLEI. N. A. Perfilov (N. Perfilow), O. V. Lozhkin (O. Łożkin), and V. P. Shamov (W. Szamow) (Inst. of Radium, Academy of Sciences, USSR). Postępy Fizyki, 12: 115-53(1961). (In Polish)

Because the deBroglie wavelength associated with particles of 10^2 to 10^4 Mev and higher energies is significantly smaller than the size of the nucleus, it appears that the investigation of the motion of such particles within the nucleus and their collisions with individual nucleons of the nucleus should be straightforward. However, the presence of excited states of the bound nucleons shows that there exist quantum rules for the preferred collision energies and consequently the mean free path of the fast particles in the nucleus is subject to these constraints. The result of the bombarding particles interacting with the bound nucleons gives rise to a cascade of fast protons and neutrons within the nucleus, and at higher bombarding energies, π mesons together with residual nuclei in excited states. The magnitude of the excitation energy is limited by the properties of cascade decay within the nucleus and can range from a small part to all of the energy of the bombarding particles. The reaction products can therefore follow two general descents: particles being knocked out from the nuclei during the development of a cascade, or heavily charged particles being emitted during the decay of the excited states of the residual nuclei (fragmentation). Conditions necessary for fragmentation, fragment structure, energy and angular distribution, properties of the residual nucleus after fragment emission, and possible fragmentation mechanisms are presented in turn. (123 references). (TTT)

31675 EFFECTIVE INTERACTION IN NUCLEAR MANY-BODY PROBLEM. Masaru Yasuno (Kobayashi Inst. of Physical Research, Tokyo). Progr. Theoret. Phys. (Kyoto), 25: 411-26(Mar. 1961). (In English)

A general treatment of the nuclear many-body problem is given in terms of Green's functions, and the correlation factor of the nucleus is derived. An effective interaction is introduced that preserves independent particle motion, and it is proved that this interaction is equivalent to the Brueckner K-matrix. Applying the properties of electron-hole pairs to the system, a collective mode is derived. The effective interaction contributing to collective motion is studied. It is also shown that this collective effective interaction is very different from that in an electron plasma. (auth)

31676 ON ENERGY MATRICES FOR THE INDEPENDENT PARTICLE MODEL. Hisashi Horie (Tokyo Inst. of Tech.) and Kiyoshi Sasaki. Progr. Theoret. Phys. (Kyoto), 25: 475-92(Mar. 1961). (In English)

A method using Fourier transforms of two-body interactions for the calculations of energy matrices in the independent particle model is proposed. The non-central and central interactions can be expanded into series of tensor products of spherical harmonics by this procedure. Furthermore, the radial integrals can be reduced to simple integrals, which involve the Fourier transforms of the radial dependence of the interactions. For the harmonic oscillator wave functions, the procedure can be easily carried out and explicit formulas for the integrals are obtained. Tables for the calculations of integrals for the central, tensor, and spin-orbit interactions are given. (auth)

31677 ON SCATTERING OF DEUTERONS BY NON-AXIAL NUCLEI. Yu. A. Berezhnoi (Khar'kov Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Ukrain. Fiz. Zhur., 6: 275-7(Mar.-Apr. 1961). (In Ukrainian)

Diffraction reactions of fast deuterons with nonspherical nuclei with elipsoidal orbits and spin zero was previously investigated. Further studies are made of the generalized case for nuclei with arbitrary spin. (R.V.J.)

31678 A METHOD FOR THE DETERMINATION OF THE HALF LIVES OF SHORT-LIVED GASEOUS RADIOISOTOPES. THE HALF LIVES OF THORON (Rn^{220}) AND ACTINON (Rn^{219}). Heinz Rodenbusch and Günter Herrmann (Institut für Anorganische Chemie, Mainz and Universität, Mainz). Z. Naturforsch., 16a: 577-82(June 1961). (In German)

A method for the indirect determination of the half lives of short-lived gaseous radioisotopes is described. The method is based on a principle used first by Makower and Geiger; it was assumed that positively charged, relatively

long-lived decay products originate from the gaseous radioisotopes. The gaseous isotopes were driven with a carrier gas through a tube in which negatively charged wire-gauze electrodes were installed. The decay products are separated on the electrodes. The activity of the electrodes was measured; it decreases exponentially with increasing distance from the source. From the decrease and the current velocity the half life of the gaseous mother substance was obtained. The method was tested with thoron and actinon and half lives of 56.6 ± 0.8 and 4.01 ± 0.06 sec were found. In direct decay measurement values of 56.3 ± 0.2 and 4.00 ± 0.05 sec were obtained, in agreement with the present results. The effect of the electrode voltage, the carrier gas, and the current velocity on the separation was investigated. At high electrode voltages, the decay products are focussed at the midpoint of the electrodes. (tr-auth)

31679 THE OPTICAL NUCLEAR MODEL. Francisco Medina Nicolau (Max-Planck-Institut für Physik and Astrophysik, Munich). Z. Naturforsch., 16a: 603-11(June 1961). (In German)

The Schrödinger equation is derived which is satisfied by the neutron wave function when this is averaged over an energy interval which is much greater than the average level spacing between the resonances of the compound nucleus. The potential involved in this equation is a non-local one, and is given in terms of the interaction between the neutron and the target nucleus and the wave functions of the target and the compound nucleus. The wave function of the system is totally antisymmetrized in order to satisfy the Pauli exclusion principle. Using a Serber force for the two body interactions and a Fermi gas model for the wavefunctions of the target and the compound nucleus, the magnitude of the real and imaginary parts of the potential used in the optical model of the nucleus is estimated. (auth)

31680 DER ISOSPIN VON ATOMKERNEN. (The Isospin of Atomic Nuclei). B. S. Dzhelepov (Dzelepov), G. I. Zeltser (Selzer), A. I. Baz (Bas), and Ya. (J.) A. Smorodinskii (Smorodinskij). Berlin, Akademie-Verlag, 1960. 163p.

Isobaric spin and similar states of atomic nuclei, isobaric spin and the hypothesis of the density independence of nuclear forces, and the isotopic spin of light nuclei are discussed. Topics covered include comparison of the forces which act between nucleons, the concept of isobaric spins, selection rules, level displacement in isobaric nuclei on account of the Coulomb energy and the mass difference between the neutron and proton, isobaric spin of several nuclei, unambiguity of isobaric spins, isobaric spin and gamma radiation and effects on nuclear excitation, isobaric spin and photoreactions of the types (γ,α) and (γ,d), isobaric spin of mesons and light particles, the quantum mechanical formulation of the density independence, energy levels of isobaric nuclei, selection rules for isobaric spin and nuclear reactions, the isotopic spin of nucleons, and levels of light nuclei. (M.C.G.)

31681 THEORY OF DIRECT NUCLEAR REACTIONS. W. Tobocman. Oxford Library of the Physical Sciences. London, Oxford University Press, 1961. 110p. $2.40—15s.

The theory of direct nuclear reactions at intermediate energies is studied, using the Born approximation and the distorted-wave Born approximation. Spin-orbit and exchange interaction effects are investigated. Polarization and γ correlation characteristics are examined. Direct reactions on deformed nuclei are considered. Attention is centered on stripping (d,p) and knock-out (p,n) reactions and inelastic scattering processes. The impulse, adiabatic, and strong coupling approximations are also studied. (T.F.H.)

Particle Accelerators

31682 (AWRE-0-12/61) ION BUNCHING SYSTEMS FOR PARTICLE ACCELERATORS. F. E. Whiteway (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). Sept. 1961. 44p.

Ideal requirements for bunching ion beams by velocity modulation are considered. Practical limitations to the ideal system are shown and expressions derived for the target current waveform for sawtooth and sine-wave bunching potentials. Factors which lead to debunching at the target are discussed, and methods for removing the unused portion of the beam are described. An optimum bunching system for a Tandem Van de Graaff accelerator is discussed. (auth)

31683 (BNL-683) CATALOGUE OF HIGH ENERGY ACCELERATORS. Mark Q. Barton, comp. (Brookhaven National Lab., Upton, N. Y.). Sept. 6, 1961. Contract [AT(30-2)-Gen-16]. 105p.

An up-to-date compilation of parameters of existing high energy accelerators is presented. Data on proton synchrotrons, electron synchrotrons, linear accelerators, and model accelerators and storage rings are presented in the form of questionnaires sent to various U. S. and foreign laboratories. (P.C.H.)

31684 (BNL-5700) EXPERIMENTAL PROGRAM REQUIREMENTS FOR A 300-1000 BEV ACCELERATOR. (Brookhaven National Lab., Upton, N. Y.). Aug. 28, 1961. Contract AT-30-2-GEN-16. 308p.

A study program was carried out to evaluate the desirability for a 300- to 1000-Bev accelerator, to analyze various known detection and particle separation techniques and to develope techniques applicable at these energies, to estimate beam kinematics and the properties of the secondaries produced in a target, to design the experimental area and shielding required for such a machine, and to consider specific experiments that would be of specific interest in this energy region. It was found that, in application of such an accelerator, a good share of the experiments would involve secondaries of various energies up to the maximum energy of the machine. By extending the current techniques to the highest possible momentum, it would be possible to detect and identify particles in the 200-Bev/c region by means of a differential gas Cherenkov counter of approximately 100 ft in length. Developments were made on techniques for identifying and separating particles at high energies using the relativistic rise characteristics in ionization loss and the small angle strong interactions. Using kinematical considerations and assuming isotropy of the secondaries in the center of mass system, it was calculated that half of the secondaries produced would be contained inside a cone of half-angle of 4.5° at 300 Bev and of 2.5° at 1000-Bev incident energy. (M.C.G.)

31685 (NP-10774) L'EVOLUTION DES POLYGONES ET DES ELLIPSES D'ACCEPTANCE LE LONG D'UN CANAL DE LENTILLES MAGNETIQUES QUADRUPOLAIRES. Rapport interne No. 611. (The Evolution of the Polygons and Ellipses of Acceptance Along Magnetic Quadrupole Lens Channels. Internal Report No. 611).

Jean Fronteau (College de France, Paris. Laboratoire de Physique Atomique et Moleculaire). Apr. 1961. 20p.

Surfaces of acceptance are defined in general terms followed by definitions for polygons and ellipses. Each case is then treated separately using the program "GAUUA ET" BULL. (T.R.H.)

31686 (TID-13418) THE UNIVERSITY OF MICHIGAN 42-INCH CYCLOTRON. Progress Report Covering July 1960 to July 1961. (Michigan. Univ., Ann Arbor. Coll. of Literature, Science, and the Arts). July 1961. Contract AT(11-1)-275. 47p. (UMRI-2842-11-P).

Experimental and theoretical research is described on the Michigan 42-inch cyclotron. The problems receiving attention include: level-structure studies of the (1d,2s) shell nuclei Na^{24}, Mg^{25}, Mg^{26}, Mg^{27}, Al^{28}, P^{32}, S^{33}, S^{35}, Cl^{36}, Cl^{38}; deuteron elastic scattering from nuclei; proton polarization in the $Be^{9}(d,p)Be^{10}$ reaction; the neutron time-of-flight spectrometer; and solid-state particle detectors. (auth)

31687 (NP-tr-740) AUTOMATIC CONTROL OF THE INSTANTANEOUS ACCELERATING FIELD IN A PROTON LINEAR ACCELERATOR. B. P. Murin and K. I. Guseva (Akademiya Nauk S.S.R. Radiotekhnicheskii Institut). Translated by J. Stuart (United Kingdom Atomic Energy Authority Atomic Energy Research Establishment, Harwell, Berks, England). June 1961. 34p.

Results are given of an investigation of a system of automatic control of the instantaneous accelerating field when an equilibrium particle passes the center of an accelerating gap. With variation of the amplitude of the field in the resonator by ±10%, the system of automatic control stabilized the accelerating field to within ±1.5 to 2%. The system of automatic control corrected phase shifts of ±5° and ±10° introduced into the hf amplification system to within ±1°. The system stabilized the accelerating field within an accuracy of ±2%. The system corrected artificially introduced detuning of the resonator with an accuracy of ±0.5°. (M.C.G.)

31688 LARGE PARTICLE ACCELERATORS. J.-L. Delcroix (Faculté des Sciences, Orsay, France). Énergie nucléaire, 3: 210-18(May-June 1961). (In French)

Large particle accelerators for protons and electrons are used for the study of the physics of elementary particles. The difference between proton and electron accelerators and the reasons for the selection of one or the other are given, and the principal types of each are described. The difficulties in the study with higher and higher energies are indicated, and the possible contribution of the crossed beam technique for the solution of these difficulties is shown. (auth)

31689 PROJECTS FOR NEW ACCELERATING MACHINES. [PART II]. Edouard Regenstreif (CERN, Geneva). Inds. atomiques, 5: No. 5-6, 55-69(1961). (In French)

Constant field alternating-gradient accelerators (CCGA) are described. The advantages and disadvantages of beam accumulation, storage rings, and crossed beams are considered. Machines of the plasma type are not yet under construction, but studies being made are reviewed. Other procedures proposed for particle acceleration (coherent acceleration, stochastic acceleration, acceleration by multiple frequency, acceleration by field scanning, and recourse to high fields) are briefly reviewed. (J.S.R.)

31690 ON THE THEORY OF SYNCHROTRON RADIATION. A. A. Sokolov and I. M. Ternov (Moscow State Univ.). Izvest. Vysshikh Ucheb. Zavedenií, Fiz., No. 2, 3-12(1961). (In Russian)

Free electron motion along a magnetic field (continuous spectrum) and limited motion along a field under conditions of potential well with an infinite boundary (discrete spectrum) are analyzed within the limits of rigid quantum theory. The latter is a postulation of the real conditions of electron motion in an accelerator with magnetic focusing along the field. The results of the analysis indicate that radiation affects electron motion only under the conditions of a continuous spectrum, i.e., under conditions of classical motion. Under conditions of a discrete spectrum (quantum motion), radiation damping of quantum fluctuation is not present. (R.V.J.)

31691 CALCULATION OF ELECTRON MOTION IN BETATRON WITH INCREASING TOROIDAL MAGNETIC FIELD. N. A. Volosnykh (Kirov Tomsk Polytechnic Inst., USSR). Izvest Vysshikh Ucheb. Zavedenií, Fiz., No. 2, 46-51(1961). (In Russian)

Formulas are developed for calculating electron trajectory in the initial acceleration in a betatron with a toroidal magnetic field at constant field growth rate. It is assumed that the curvature of the betatron chamber is small. (R.V.J.)

31692 FIELDS IN CAVITY-EXCITED ACCELERATORS. E. G. Cristal and J. Van Bladel (Univ. of Wisconsin, Madison). J. Appl. Phys., 32: 1715-24(Sept. 1961).

Field configuration and resonant frequency are determined for the lowest azimuthally-independent mode of a coaxial cavity surrounding a circular tube. Several values of the width of the coupling gap are considered, and the central problem consists in determining the tangential electric field E_t in that gap. It was found that the fields near the axis of the accelerator are quite insensitive to the actual profile of E_t, and that satisfactory results are obtained by assuming E_t to be constant. The problem is repeated for a parallel plane configuration, with the purpose of investigating the influence of the flattening of the cavity. Computations show that the two configurations yield fairly similar results. (auth)

31693 INJECTOR FOR H^- IONS. Yu. M. Khirnyi and L. N. Kochemasova. Pribory i Tekh. Ekspt., 6: No. 2, 14-19(Mar.-Apr. 1961). (In Russian)

Calculations and experimental data are given for the focusing system of two variations of negative hydrogen ion injector for recharging an electrostatic generator. (tr-auth)

31694 AN ANNULAR CYCLOTRON WITH RADIAL SECTORS. Miroslav Karmasin (Joint Inst. for Nuclear Research, Dubna, USSR). Jaderná energie, 7: 265-71 (1961). (In Czech)

The physical principles of the annular cyclotron with radial sectors are described and discussed. Among the principles described are those of magnetic field configuration, strong focusing, and transverse oscillation stability and resonance influences. The laws of resonance and induction particle acceleration are derived for high intensity electrons and protons. Some of the problems of charged particle accelerators are also discussed. (N.W.R.)

31695 ON THE RADIO-FREQUENCY SYSTEM OF A 30 Mev MICROTRON. PART II. M. Innas Ali (Univ. of Dacca, Pakistan). Pakistan J. Sci. and Ind. Research, 3: 149-55(July 1960). (In English)

The main advantage of a microtron over other types of electron accelerators are indicated, and a general description of a 30 Mev microtron is given. Consideration of the requirements of a cavity resonator from the point of view

of microtron dynamics leads to the choice of a conical line resonator with flattened cones and cylindrical surface. The resonant frequency of the resonator is calculated by the method of perturbation. The resonator was designed and constructed in the laboratory and its electrical properties measured. The results are found to be satisfactory. (auth)

31696 CYCLOTRON BEAM EXTRACTION SYSTEM. N. N. Atlashkin, G. N. Dobrolyubov, A. A. Zaitsev, I. I. Levintov, E. G. Savinov, V. P. Sokolov, B. M. Stasevich, and I. S. Trostin (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR). Pribory i Tekh. Ekspt., 6: No. 3, 18-21(May-June 1961). (In Russian)

The magnetic strong-focusing beam handling system is described for a 1.2-m magnet pole cyclotron. The system consists of a magnet channel for directing the beam and focusing it in the horizontal plane; two pairs of quadrupole magnetic lenses; and several remote control diaphragms. A neon-filled chamber is used for beam observations. A television installation is used for observing beam-induced gas luminescence. The 12.3-Mev deuteron beam current 8 m from the cyclotron is 33 $\mu a/cm^2$. Total current for a remote target is 5 μa. (tr-auth)

31697 CYCLOTRON NON-INCANDESCENT ON SOURCE. I. S. Trostin, E. G. Savinov, and B. M. Stasevich. Pribory i Tekh. Ekspt., 6: No. 3, 22-5(May-June 1961). (In Russian)

Descriptions are given of a cyclotron "cold cathode" ion source. An arc discharge with electron oscillations along a magnetic field is used. The source is capable of continuous or pulsed operation and is used for producing D^+ ions. The life of the source in continuous operation is 200 hours and over 500 hours in pulsed operation. The source increased beam current by a factor of 2 in the terminal orbits and stabilized cyclotron performance. (R.V.J.)

31698 ELECTRON GENERATOR OF 500 KEV. A. P. Senchenkov and S. V. Kersnovskii. Pribory i Tekh. Ekspt., 6: No. 3, 26-32(May-June 1961). (In Russian)

A 500-kev, 250-μa electron beam generator is described. An electrostatic generator with a strong rotor generates the high voltage. The high-voltage generator is enclosed in a container filled with SF_6. (R.V.J.)

31699 HIGH-FREQUENCY CHARACTERISTICS OF A "LONG" RESONATOR IN A HEAVY NUCLEI LINEAR ACCELERATOR. L. I. Bolotin, V. A. Bomko, and E. I. Revutskii (Khafkov Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Ukrain. Fiz. Zhur., 6: 157-62 (Mar.-Apr. 1961). (In Ukrainian)

The solution of problems concerning the slight difference between a frequency oscillation E_{010}-wave used for accelerating and frequencies E_{011} in a resonator of great electrical length is considered. The high-frequency characteristics of a drift-tube resonator (quality factor and shunt impedance) are given. (auth)

31700 EQUALIZATION OF THE ACCELERATING FIELD IN A "LONG" RESONATOR OF A HEAVY NUCLEI LINEAR ACCELERATOR. L. I. Bolotin, V. A. Bomko, and E. I. Revutskii (Khafkov Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Ukrain. Fiz. Zhur., 6: 163-7(Mar.-Apr. 1961). (In Ukrainian)

Methods are developed for equalizing the accelerating field of the drift-tube resonator. A short description of the apparatus used and the methods of measuring fields are given. The method was used to equalize the field resonator to within ±1 to 2%. (auth)

31701 ELECTRON CAPTURE IN STATIONARY BETATRON ACCELERATION. A. P. Komar, G. F. Mekheev, V. P. Fominenko, and N. N. Chernov (Leningrad Inst. of Physics and Tech.). Zhur. Tekh. Fiz., 31: 740-5(June 1961). (In Russian)

The contribution of electrons captured at various regions to the total current of captured electrons was investigated. It was found that the spatial charge created by electrons emitted from the injector before and after capture does not affect the capture conditions. At optimum conditions the capture takes place predominantly near equilibrium orbits. An increased intensity can be achieved by selecting an interval of capture which satisfies nearly equilibrium orbits corresponding to the invariable heterogeneity of a given accelerator. At small emission currents an additional intensity can be developed by contraction effects. (R.V.J.)

31702 THE LOSS OF PARTICLES IN ELECTRON ACCELERATORS CAUSED BY THE QUANTUM FLUCTUATIONS OF RADIATIONS (PHASE OSCILLATIONS). S. A. Kheifets, Yu. F. Orlov, G. V. Gendzhoyan (Inst. of Physics, Academy of Sciences, Armenian SSR and Computer Center, Academy of Sciences, Armenian SSR). Zhur. Tekh. Fiz. 31: 824-9(July 1961). (In Russian)

The results of numerical calculations are presented for the fractional loss of particles in an electron accelerator. The loss is expressed in terms of three parameters. Also, an approximate formula for the loss of electrons due to quantum fluctuations of radiation is obtained by means of calculations for the attenuation of electron oscillations. Both radial and phase oscillations of accelerated electrons play an important role in the loss of these particles. The fractional loss is given for a range of values of β, a parameter that depends on the type of coupling between radial and phase oscillations. β determines the rate of radiation damping. Its value is zero for the usual strong focusing accelerators. The results of the more accurate machine calculations show that the approximate equation is qualitatively correct, with agreement between the two improving with decreasing values of β. (TTT)

31703 THE APPLICATION OF KRAMER'S METHOD FOR THE CALCULATION OF THE LOSS OF PARTICLES IN CYCLE ACCELERATOR'S CAUSED BY SCATTERING DURING BETATRON OSCILLATIONS. A. N. Didenko and A. N. Vall (Tomsk State Univ., USSR). Zhur. Tekh. Fiz., 31: 830-3(July 1961). (In Russian)

Kramer's method, derived for the analysis of the Brownian motion of particles through a potential barrier, is used to determine the loss of particles due to scattering during betatron oscillations. The results are summarized in graphs showing the percentage loss plotted versus the residual gas pressure. Losses do not exceed 5 to 10% for residual pressures of less than 5×10^{-5} mm of Hg. This method holds for injection energies exceeding 0.56 Mev. (TTT)

31704 APPARATUS FOR CONTROL OF HIGH-ENERGY ACCELERATORS. Harry G. Heard (to U. S. Atomic Energy Commission). U. S. Patent 3,005,954. Oct. 24, 1961.

A particle beam positioning control for a synchrotron or the like is described. The control includes means for selectively impressing a sinusoidal perturbation upon the rising voltage utilized to sweep the frequency of the f-m oscillator which is conventionally coupled to the accelerating electrode of a synchrotron. The perturbation produces a variation in the normal rate of change of frequency of the accelerating voltage applied to the accelerating electrode, resulting in an expansion or contraction of the particle

beam orbit diameter during the perturbation. The beam may thus be controlled such that a portion strikes a target positioned close to the expanded or contracted orbit diameter and returns to the original orbit for further acceleration to the final energy. (AEC)

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31705 (ARL-126) SOME CHARACTERISTICS OF A TOROIDAL PINCH WITH A REVERSED FIELD. Technical Note No. 4. S. Berglund and S. Svennerstedt (Uppsala Univ. Inst. of Physics). May 17, 1961. Contract AF61(052)-170. 9p.

A description is given of an experimental setup for a large toroidal pinch. The primary system creates in the following order: a weak quasi-stationary axial field, the main gas current, and a strong pulsed axial field in opposite direction to the weak one. The plasma fields and associated motions were studied by magnetic probes, and the ionization stages of various elements in the discharge were studied by optical spectroscopy. Results on the stability and the general behavior of different discharge types are given. (auth)

31706 (AWRE-0-7/61) A METHOD OF MEASURING THE IONIZATION CROSS-SECTIONS OF MULTIPLY IONIZED GASEOUS ATOMS. A. L. T. Powell and W. H. W. Fletcher (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). Sept. 1961. 18p.

The theory is given of a method of measuring ionization cross sections of multiply ionized gaseous atoms and demonstrates how it can be applied by giving some preliminary results using oxygen. A fully ionized deuterium plasma, produced by the collision of two plane shock waves, is used as the ionizing medium and the cross sections are measured from the temporal observation of the intensity of a spectral line emitted by an ion added to the plasma. (auth)

31707 (CLM-L-2) LECTURES ON THE HYDROMAGNETIC STABILITY OF A CYLINDRICAL PLASMA. VIII. THE ROLE OF ANISOTROPIC PRESSURE IN THE THEORY OF THE STABILIZED PINCH. R. J. Tayler (United Kingdom Atomic Energy Authority. Research Group. Culham Labs., Culham, Oxfordshire, England). Aug. 1961. 32p.

In the simple theory of the stabilized pinch it is assumed that the plasma has isotropic pressure. In practice this may well not be true and it is known that new instabilities may arise when the pressure is anisotropic. In particular, in the simple theory, the uniform magnetic field in the plasma always exerts a stabilizing influence whereas plane waves propagating in a uniform magnetic field may be unstable if the pressure is anisotropic. This lecture is divided into two main parts. In the first the qualitative effect of anisotropic pressure is demonstrated by supposing the plasma to be governed by the double adiabatic hydromagnetic equations of Chew, Goldberger, and Low. These equations neglect heat flow along field lines and they underestimate the instability. In the second part a more accurate dispersion relation, given by Chandrasekhar, Kaufman, and Watson, is solved for several values of the ratio of parallel and perpendicular components of pressure. In this case both ion and electron distribution functions are assumed to be Gaussian in both parallel and perpendicular components of velocity and the ratio of parallel to perpendicular pressure is taken to be the same for each species. It is shown that the domain of instability increases if the ratio of pressures is either very large or very small but that the greatest stability occurs when the parallel pressure slightly exceeds the perpendicular pressure. (auth)

31708 (LAMS-2619) LASL CONTROLLED THERMONUCLEAR RESEARCH PROGRAM. Quarterly Status Report for Period Ending August 20, 1961. (Los Alamos Scientific Lab., N. Mex.). Sept. 1961. Contract W-7405-ENG-36. 44p.

Stability studies were made of the plasma jet from a hydromagnetic gun as it passed through either converging or diverging axial magnetic fields in the caulked picket fence system. Results showed that the plasma boundary is more stable in the converging field but there is focusing or guiding of the jet by both types of fields. Time-resolved measurements of Doppler broadening of the He II 4686 A line in the full-scale model caulked picket fence showed confinement times of ≥ 40 μsec for He ions of ~330 ev energy. In the Mark II (bakeable) picket fence experiment, confinement times of deuterium plasma injected into the system from hydromagnetic guns were determined from measurements of the neutrons produced by D-D reactions. Experimental work on the orthogonal pinch system using 3-μsec rise time was terminated. Simultaneous measurements were made of the incoherently scattered S-band microwaves and incident and reflected 28 Mc/sec rf power in the scattering chamber. A scattering resonance as observed associated with a strong impedance mismatch brought about by a sudden change in the impedance of the discharge when rf electric fields become large in the plasma. Statistical mechanics analysis based on Liouville's theorem, similar to that used in accelerator design, was applied to the resonant helix injection device to determine the maximum particle densities that can be obtained in such a system with practical ion sources. Results indicated maximum theoretical densities of $\sim 10^{11}$ particles/cm^3. Probe measurements and time resolved photographs of the plasma in motion down the barrel of the coaxial hydromagnetic gun indicated an unstable spoke discharge rather than a uniform plasma region with initial gas densities $\leq 10^{14}$ particles/cm^3. Measurements of plasma jet penetration through a transverse magnetic field showed that the jet penetrates through a 500-gauss barrier without measurable loss in density but is either stopped or deflected outside the acceptance area of the detector by a 1000-gauss barrier. The electron temperature (T_e) of Scylla III was measured with the beryl crystal x-ray spectrometer and by a two-absorber soft x-ray detector. The two-gun plasma collision apparatus was adapted to the injection of plasma into Scylla III. Operation of the E × B apparatus was markedly improved by withdrawing the coaxial gun injector from the region of transverse E and B fields, thus eliminating shorting of the transverse E field by the gun electrode. An unsuccessful search was made of the visible spectrum from Scylla I in an attempt to find untabulated lines of Ne IX. Progress is being made in the design of various components of the 3.5-megajoule Scylla IV magnetic compression experiment. (auth)

31709 (NBS-6737) ON THE CRYOGENIC ASPECTS OF PROJECT SHERWOOD. Fourth Progress Report, October 1, 1960 to December 31, 1960. (National Bureau of Standards. Boulder Labs., Boulder, Colo.). Dec. 31, 1960. 21p.

A superconducting Nb solenoid was constructed with a

calculated maximum magnetic field of 10.3 kilogauss at 1.1°K. The development of a 100-kilogauss laboratory magnet is described. A detailed discussion is presented on the problem of defining the efficiency of an ideal refrigerator, and a method is outlined for comparing refrigeration processes. Typical load vs plate separation curves are presented for gas-lubricated bearings tested in a flat plate apparatus. (D.L.C.)

31710 (NBS-6761) ON THE CRYOGENIC ASPECTS OF PROJECT SHERWOOD. Fifth Progress Report, January 1, 1961 to March 31, 1961. (National Bureau of Standards. Boulder Labs., Boulder, Colo.). Mar. 31, 1961. 15p.

The superconductivity of a Nb_2Sn wire was studied in pulsed magnetic fields of 185 kilogauss, and the critical field was found to be ~188 kilogauss at 1.6°K. Electrical resistivity measurements are reported for high-purity Al. The status of refrigeration cycle analysis is described. The turbo-expander, for use in a He refrigeration system, was tested and its gas-lubricated bearings found stable at operation up to 7 kw refrigeration. (D.L.C.)

31711 (NBS-6784) ON THE CRYOGENIC ASPECTS OF PROJECT SHERWOOD. Sixth Progress Report, April 1, 1961 to June 30, 1961. (National Bureau of Standards. Boulder Labs., Boulder, Colo.). June 30, 1961. 13p.

Work on superconducting magnets is described. An investigation was made of the performance of two N_2 systems for refrigeration at temperatures above 66°K: single JT valve and series expansion engine. (D.L.C.)

31712 (NP-10619) A MICROWAVE REFLECTION METHOD TO DETERMINE PLASMA COLUMN RADII. Rijnhuizen Report 61-04. L. Th. M. Ornstein, L. H. Th. Rietjens, and W. J. Schrader (Stichting Voor Fundamental Onderzoek der Materie. Instituut Voor Plasma-Fysica, Jutphaas, Netherlands). Aug. 1961. 13p.

A plasma in a microwave beam causes reflection and diffraction. If the electron density is above cut-off and if the boundary is sharp, the plasma acts as a perfect reflector. Reflected and diffracted signals can then be used to obtain information about the geometrical extent of the plasma. These experimental data can be interpreted with the aid of analog measurements, e.g., on metal cylinders of various diameters which are substituted for a plasma column. This method was applied with 8-mm waves to a toroidal pinch discharge in an 8-cm bore glass vessel. A good correlation of the obtained results with pictures from a fast-framing camera as well as with signals from a Rogowski coil was found. (auth)

31713 (NP-10686) THE STABILITY OF AN ALTERNATING PINCH DISCHARGE. Rijnhuizen Report 61-03. P. C. T. Van Der Laan and L. H. Th. Rietjens (Stichting Voor Fundamenteel Onderzoek der Materie. Instituut Voor Plasma-Fysica, Jutphaas, Netherlands). Aug. 1961. 18p.

Experiments were carried out to study the stability of an alternating pinch discharge. In the discharge, a plasma column is confined by B_z- and $B\theta$-fields, oscillating with the same frequency, with a phase difference of 90°. The confining fields are induced by two primary helical windings, wound with opposite pitch around a torus. The primary windings are connected to charged capacitors by means of spark-gaps, triggered with an adjustable time delay. Resonant frequencies of the LC circuits are 80 kc/s; the primaries are wound so as to give a low magnetic coupling. In any point of the surface of the plasma, the alternating pinch fields can, in first order, be thought of as a magnetic field, constant in magnitude, and rotating in a plane tangential to the plasma column. The field is penetrating into the plasma, and if the applied frequency, ω, is smaller than the collision frequency, ν_c, a shear is produced in the magnetic field lines in the skin of the plasma. A necessary condition for stability in cylindrical geometry is derived from the Suydam criterion, assuming the skin depth to be small compared to the radius of the plasma column, r_o. For a given r_o, this stability criterion, together with the requirement $\omega \ll \nu_c$ and the Bennett relation, yields combinations of electron temperatures and densities, where experiments can verify the validity of the theory. Experiments are described by which the z-pinch, the θ-pinch, and the alternating pinch are compared. The choice between these different pinch configurations can be made by the adjustable time delay. (auth)

31714 (NP-10741) ENERGY TRANSFER PROCESSES IN A PARTIALLY IONIZED GAS. Hypersonic Research Project Memorandum No. 61. Gordon L. Cann (California Inst. of Tech., Pasadena. Guggenheim Aeronautical Lab.). June 15, 1961. Contracts DA-04-495-Ord-1960 and 3231. 214p.

An analysis was made of the transport properties of a partially ionized gas subject to the constraint that the average random energy of all constituent particles is exactly equal (equipartition of energy). A set of tractable equations describing the mass and energy diffusion in a partially ionized gas was obtained that included all terms correct to the order of the square root of the ratio of the electron to atom mass compared to one. The transport coefficients were evaluated for helium and argon over the complete range of partial ionization assuming that the species particle densities are quite close to their equilibrium values. The analysis indicated that the electron and ion diffusion velocities are more closely coupled than the equations of Chapman and Cowling show. The added coupling implicitly applied the constraint of zero mass velocity to the gas locally. Because of this constraint a current in the direction of $(E \times B) \times B$ occurred in addition to the direct and Hall currents. It is shown that the only part of the thermal conductivity that can be influenced by a magnetic field is that part of the energy carried by the diffusion of the charged particles. The development of a similarity solution for axially symmetric electric discharges is described. A number of parameters were obtained and discussed. The solution was evaluated for a discharge in argon gas at one atmosphere pressure in which the temperature on the axis of the discharge varied from 6,000 to 19,000°K. The current-voltage characteristic obtained from this solution was compared with an experimentally determined curve of H. Maecker. The mechanisms of energy transfer in arc jet devices are discussed. The relative magnitude of the amount of energy that is transferred to the gas in the various parts of the electric discharge was determined. The various possible electrode configurations are discussed in detail and compared. The design and performance of an annular electrode arc heater with a rotating arc is described and discussed. A modified heater was constructed with the cathode emission occurring along the axis of the applied magnetic field. Details of the performance of this configuration are given. It is shown that the arc potential drop depends primarily on the strength of the applied magnetic field and the gas enthalpy downstream of the arc. The dependence of the arc potential drop on the arc current and the ambient pressure is shown to be weak over the ranges tested, e. g., 50 to 300 amperes for the current and 1 to 4 atmospheres for the pressure. Some heat transfer measurements taken with this equipment are presented. An evaluation was made of the transport coefficients in a par-

tially ionized gas. Formulas were developed for determining the viscosity, thermal conductivity, and electric conductivity of the plasma. These coefficients were computed for argon and helium at one atmosphere pressure and over the temperature range of partial ionization. (auth)

31715 (NYO-9496) CONTAINMENT IN CUSPED PLASMA SYSTEMS. Harold Grad (New York Univ., New York. Inst. of Mathematical Sciences). Mar. 30, 1961. Contract AT(30-1)-1480. 24p. (MF-15)

A survey of the current theoretical picture of plasma containment in cusped magnetic configurations is presented together with a mention of the points of contact which exist or might soon be made to exist with experiment. A theory of containment was developed which is applicable to the whole range of plasma densities from a tenuous plasma in an essentially vacuum magnetic field to a fully developed plasma which completely excludes the magnetic field from its interior. Also presented are cursory accounts of the situation with regard to stability, cyclotron radiation, and methods of creating this type of plasma configuration. (auth)

31716 (RISÖ-28) AN EXPERIMENT ON MAGNETICALLY DRIVEN SHOCKS. V. O. Jensen, A. H. Sillesen, F. Heikel Vinther, and C. F. Wandel (Denmark. Atomenergikommissionen. Forsogsinstitut, Risø). June 1961. 13p.

Prepared for the Conference on Plasma Physics and Controlled Nuclear Fusion Research, Salzburg, 1961.

An apparatus is described in which a high current discharge between two parallel plates acts as a piston producing plane shocks in a rarefied gas. The apparatus can either be used for studying the development of a single shock or for studying two colliding shocks. Shock velocities up to 12 cm/μs are measured in H_2 and He. The shock velocities obtained with different currents and gas pressures are compared with theoretical calculations based on the "snow-plow" model. For pressures higher than 1 mm Hg good agreement is found, but for lower pressures the agreement is not as close. The current distribution in the discharge chamber is investigated with a magnetic coil. A small current density is found in front of the shock. Behind the current maximum that produces the shock, another (nearly stationary) current peak is found. (auth)

31717 (TID-13095) LOW-FREQUENCY FLUCTUATIONS IN PLASMA: GENERATION MECHANISMS AND THEIR SUPPRESSION. F. W. Crawford (Stanford Univ., Calif. Microwave Lab.). May 1961. Contract AT(04-3)-326. 32p. (ML-813).

Generation mechanisms for the low-frequency fluctuations occurring in the discharge parameters of hot-cathode mercury-vapor plasmas are discussed. The influence of the type of cathode used and the geometry of the tube were investigated, and it is concluded that some prominent components of the frequency spectrum of the fluctuations may be associated with radial ion wave modes. Explanations for components generated close to the cathode which have systematic variations with anode current are suggested. Techniques involving magnetic fields and close-spaced grids were applied to achieve a substantial degree of noise suppression. (auth)

31718 (TID-13203) ON THE CRYOGENIC ASPECTS OF PROJECT SHERWOOD. First Progress Report, September 1, 1959 to March 31, 1960. (National Bureau of Standards. Boulder Labs., Boulder, Colo.). Mar. 31, 1960. 41p. (CM-5)

A program was initiated to provide intense magnetic fields with a minimum expenditure of power by exploiting the very low electrical resistivity of some metals at low temperatures. The development of a superconducting magnet is discussed. An IBM-650 computer is being used to process thermodynamic data and to perform cooling-cycle analyses, and results are given for thermodynamic analyses of low-temperature refrigerating systems. A small experimental helium expansion turbine with gas-lubricated bearings for a helium refrigeration system is described. (D.L.C.)

31719 (TID-13204) ON THE CRYOGENIC ASPECTS OF PROJECT SHERWOOD. Second Progress Report, April 1, 1960 to June 30, 1960. (National Bureau of Standards. Boulder Labs., Boulder, Colo.). June 30, 1960. 6p. (CM-6)

Work on superconducting magnets and associated equipment is summarized. A superconducting Nb solenoid was constructed with a maximum field of ~2600 gauss; quenching by leads occurred. Difficulties were encountered in making leads which will not quench superconductivity at low fields for a laboratory magnet. The status of the thermodynamic data tabulation is outlined for He, H_2, and N_2. (D.L.C.)

31720 (TID-13205) ON THE CRYOGENIC ASPECTS OF PROJECT SHERWOOD. Third Progress Report, July 1, 1960 to September 30, 1960. (National Bureau of Standards. Boulder Labs., Boulder, Colo.). Sept. 30, 1960. 20p. (CM-9)

Work on superconducting magnets is described. Design specifications are presented for a laboratory magnet which will be cooled by liquid H_2. Equipment are described for measured the electrical resistivities of pure metals at cryogenic temperatures. A Control Data Corp. 1604 computer replaced the IBM 650 computer previously used for thermodynamic cycle analysis. Results are presented for a performance analysis of a two-engine He refrigeration cycle operating between 10 and 65°K. Progress is reported for the development of a turbo-expander for use in large-scale He refrigeration cycles. (D.L.C.)

31721 (TID-13298) STUDIES OF PLASMA OSCILLATIONS. Quarterly Status Report No. 6, March 1—May 31, 1961. (Stanford Univ., Calif. Microwave Lab.). July 1961. Contract AT(04-3)-326. 12p. (ML-828)

Plasma fluctuations in the (0 to 1 Mc) band and the microwave band are studied. Plasma tubes are described that are designed for studies of the production mechanisms and reduction techniques for these oscillations. Relationships between fluctuations in the two bands are discussed. (T.F.H.)

31722 (UCRL-3717) NONADIABATIC EFFECTS IN SINGLE-PARTICLE ORBITS. A. Garren, L. Henrich, T. Northrop, R. Riddell, and L. Smith (California. Univ., Berkeley. Radiation Lab. and California. Univ., Livermore. Radiation Lab.). Mar. 1957. Decl. Sept. 23, 1958. Contract W-7405-Eng-48. 11p.

The containment of a charged particle in a mirror field is studied analytically and numerically. Formulas are given for the change in the particle's magnetic moment as it passes from one end of the machine to the other. By following particles for many mirror reflections, it is found that for most particles the change in the magnetic moment is predominantly oscillatory, rather than random or cumulative. Numerically, these particles seem to be bound indefinitely. (auth)

31723 (UCRL-4840) DESCRIPTION OF A THERMONUCLEAR REACTOR BASED ON THE USE OF A LAYER OF RELATIVISTIC ELECTRONS TO CONFINE AND HEAT

THE PLASMA. Nicholas C. Christofilos (California. Univ., Livermore. Lawrence Radiation Lab.). Mar. 14, 1957. Decl. Sept. 17, 1958. Contract W-7405-eng-48. 24p.

A long layer of rotating relativistic electrons was employed in a proposed scheme of a thermonuclear reactor to provide a closed pattern of magnetic field liens and to heat the plasma to fusion temperature. Parameters of a production machine and experimental model are presented. The general requirements for the plasma confinement at adequate density and temperature are summarized. Establishment of the electron layer is described. The equilibrium of the plasma under these conditions was investigated and the stability of this equilibrium distribution determined. (M.C.G.)

31724 (UCRL-6381(Add.)) PRODUCTION AND CONTAINMENT OF HOT DEUTERIUM PLASMAS IN MULTISTAGE MAGNETIC COMPRESSION EXPERIMENTS. F. H. Coensgen, W. F. Cummins, W. E. Nexsen, Jr., and A. E. Sherman (California. Univ., Livermore. Lawrence Radiation Lab.). [1961]. Contract W-7405-Eng-48. 12p.

An experiment is re-examined in which a deuterium plasma is heated and compressed in successive stages, each stage occurring in a different location. The effects of adding an additional stage are investigated. The neutron spectra from d-d reactions in the plasma are shown, and the β value of the plasma is approximated. The ion energy and density are found to be 3.5 kev and $2.10^{13}/cm^3$, respectively. (T.F.H.)

31725 (AEC-tr-4837) EXPERIMENTAL INVESTIGATION OF PLASMA INSTABILITIES IN A TRAP WITH MAGNETIC MIRRORS. M. C. Ioffe and E. E. Yushmanov (International Atomic Energy Agency, Vienna). Translated by A. H. Snell (Oak Ridge National Lab., Tenn.) from Conference Paper presented at Conference on Plasma Physics and Controlled Nuclear Fusion, Salzburg, Austria, September 4-8, 1961. 18p.

Hypotheses concerning the effects of conducting walls surrounding plasma on the speed of loss arising from flute instabilities were tested. The detailed character of pulsations of the plasma density in regions of a trap was examined along with the radial density distribution of the plasma, and the dependence of the plasma retention time on its density. The hypotheses were confirmed by the experimental work. (J.R.D.)

31726 (UCRL-Trans-220(L)) SOME PROBLEMS OF THEORY OF NONUNIFORM NONISOTHERMIC PLASMA. I (AND II). Yu. L. Klimontovich. Translated by S. Shewchuck (Univ. of California Radiation Lab., Livermore) from Zhur. Eksptl'. i Teoret. Fiz., 21: 1284-1302(1951). 25p.

An equation was studied considering the coulomb interaction of charged particles and their interaction through collision with atoms of a gas. A distribution function for velocities was computed for a case when the effective cross section of an elastic scattering of electrons is inversely proportional to the velocity. (auth)

31727 THE MECHANISM OF THE CATHODIC PART OF A GLOW DISCHARGE. F. Wächter (Faculty of Mathematics and Physics, Bucharest). Ann. Physik (7), 8: 31-41 (1961). (In German)

The mean decay time and the number of charge carriers in front of a cathode were discussed in dependence on the field pattern. By means of an elementary theory of the cathodic part of the discharge, it was shown that conclusions can be drawn from field strength measurements on the plasma efficiency (contribution of the ions of the negative glow discharge to the maintenance of the discharge). From the stationary conditions it was determined that the principle contribution to the electron extinction can not be ascribed to the photoeffect. (tr-auth)

31728 ELECTRON AND GAS TEMPERATURE IN THE POSITIVE COLUMN OF HIGH CURRENT GLOW DISCHARGE AT ATMOSPHERIC PRESSURE. Helmut Prinzler (Deutsche Akademie der Wissenschaften, Berlin). Ann. Physik (7), 8: 42-59(1961). (In German)

Measurements of the electron and gas temperatures and of the gradients and current densities in the positive column of a direct current glow discharge in the current range from 50 to 400 ma were described. The determination of the electron temperature was made from the noise of the discharge at 20 cm. The discharge burns in the axis of a cylindrical hollow resonator, which was excited in the E_{01} waves and its noise temperature was measured with a special receiver. The distribution into thermal noises and shot noises gave values for the electron temperature which lie between 14,000 and 22,000°K. For a discharge in nitrogen, the gas temperature could be determined from the intensity distribution of the rotation lines of the electron band at 3371 A; it increases from about 4000°K in low currents to about 7000°K at high currents. In the discharge a considerable deviation from thermal equilibrium also exists. Under the assumption of a Maxwell velocity distribution of the electrons, the ratio of the power in the plasma to the power fed from the applied field can be calculated. This ratio varies with the gradients and is always smaller than 100. In thermal equilibrium, values between 10^4 and 10^6 are expected according to Weizel and Rompe. (tr-auth)

31729 APPARATUS PRODUCING A PLASMA ARC WITH A VIEW TO INTERNAL INJECTION IN A MAGNETIC BOTTLE. Claude Brachet and Pierre Vasseur (École Polytechnique, Paris). Compt. rend., 253: 86-8(July 3, 1961). (In French)

It was proposed to inject high energy ions into a magnetic bottle in order to produce a plasma. With this aim a new apparatus producing a plasma arc was constructed beginning with a Philips ionization gage. (tr-auth)

31730 TRANSVERSE REFRACTIVE INDEX OF A PLASMA CLOSE TO CYCLOTRON FREQUENCIES AND THEIR HARMONICS. V. P. Demidov. Doklady Akad. Nauk S.S.S.R., 139: 1342-4(Aug. 21, 1961). (In Russian)

Oscillations of a uniform infinite plasma in a constant, homogeneous magnetic field H_0 directed along the z axis are considered. The wave vector $\underline{k}$ is directed along the x axis. The tensor components of the dielectric penetrability are derived with the assumption of a Maxwellian distribution of velocities. The behavior of the refractive index $\underline{r}$ (or N^2) is considered as a function of the frequency close to m $\Omega_{e\alpha}$ (assuming that $\Omega_p^2 \gg \Omega_e^2$). In the unusual wave (the electric wave field is perpendicular to the constant magnetic field H_0) $N^2 = \epsilon_{yy} + (\epsilon_{xy}^2/\epsilon_{xx})$. The thermal motion of the electrons has only a slight effect on the behavior of the refractive index close to the ion cyclotron resonance and its harmonics. At the point where the refractive index is different from the behavior of N^2 in a cold plasma, the width is of the order of the ratio of the gas pressure to the magnetic pressure at the first two resonances, and decreases as $(P_{gas}/P_{mag})^{m-1}$ for subsequent resonances. Higher resonances were not considered because dissipative processes were not taken into account. In considering the behavior of the refractive index close to the electron cyclotron frequency and its harmonics ($\omega^2 \ll \Omega_{pe}$), it was found that N^2 can have 1, 2, 3, 4 or no

real values. On taking the thermal motion into account, a transmission band ($N^2 > 0$) is found in the region of frequencies, where N^2 was previously found to be negative if the thermal motion were neglected. The relative width is the same as that found for the ion cyclotron frequency. (TTT)

31731 HETEROGENEOUS PLASMA TURBULENCE IN STRONG MAGNETIC FIELD. M. M. Prudnikov. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk. Mekh. i Mashinostr., No. 4, 10-13(July-Aug. 1961). (In Russian)

Heterogeneous turbulence in incompressible, isotropically conducting fluid in a magnetic field was investigated. The results show that the mechanism of turbulence differs sharply from that of an ordinary hydrodynamic turbulence. In the presence of an external magnetic field the magnetic viscosity, appearing with the induction current, is the basic dissipation mechanism. This unique mechanism leads to such a fast dissipation of turbulence that inertia and induction exchange and redistribution of energy do not have time to form. The derived expression for energy dissipation per unit time, $\partial u_i(r)/u_i(v)/\partial t$, holds for the total wave number range. (R.V.J.)

31732 A PROJECT FOR THE OBTENTION OF CONTROLLED NUCLEAR FUSION. K. Nowak. Neue Physik, 2: 90-103(1960). (In German)

A new method for obtaining controlled nuclear fusion is discussed. In the conduction of accelerated ions for fusion, the necessary proximity can be effected by the obtention of similar spiral orbits, that is, the collision probability can be increased. Around the reaction space a concentrating magnetic field is placed which amplifies existing eigenconcentrations of the atomic ion beam and reduces the spiral loop distance or the wave length of the ionic motion. The spiral orbit runs tube-like along the cylinder jacket surface and is overlapped in the reaction zone. An effect analogous to the known catalyzing effect of μ mesons appears obtained by an electron stream introduced in the reaction room since the same type of effect is to be expected with electrons as the binding agent. With the proximity of the ions at a distance of the order of magnitude of 10^{-13} cm atomic formation does not appear to be stable or predictable, but electrons from contracted positive ion beams would be absorbed and nuclear fusion would be favored. The atomic ion–electron plasma arising can be considered as high temperature plasma. By the application of proportioned atomic ion masses and proportioned electron masses fusion can be obtained under safe control. (tr-auth)

31733 THE CHARGE CORRELATION FUNCTION OF A PLASMA IN A MAGNETIC FIELD. S. F. Edwards (Univ. of Manchester, Eng. and Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phil. Mag. (8), 6: 61-9(Jan. 1961).

A linear integral equation was derived for the correlation function in the presence of a magnetic field, solved, and the errors estimated. (auth)

31734 A NEW APPROACH TO TRANSPORT PROBLEMS IN FULLY IONIZED PLASMAS. S. F. Edwards and J. J. Sanderson (Univ. of Manchester, Eng. and Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phil. Mag. (8), 6: 71-87(Jan. 1961).

Exact formulas for transport coefficients are given in terms of one- and two-body equilibrium Green functions in velocity space. Equations were derived for these Green functions which apply under plasma conditions and which automatically include shielding and plasma oscillation effects. The method is illustrated by simple examples. (auth)

31735 A VARIATIONAL APPROACH TO CORRELATION IN AN ELECTRON GAS. W. H. Young (The University, Sheffield, Eng.). Phil. Mag. (8), 6: 371-7(Mar. 1961).

A method is proposed for calculating correlation energies and pair functions associated with an electron gas at any density. Upper bounds to the exact energy, lying however at least as low as the corresponding plane wave results, are guaranteed. Exact solutions were obtained in the high- and low-density limits. The technique used was that of allowing a periodic electron density. A proof emerged of the recent conjecture of Overhauser that there exist one-particle states energetically more favorable than the usual plane wave orbitals. It was concluded that in the ground state a single-particle approximation implies static spin density waves of wavelength proportional to the usual separation electron parameter r_s, at least for r_s sufficiently large. (auth)

31736 OSCILLOGRAPHIC METHOD FOR MEASURING PLASMA GAS DISCHARGE PARAMETERS. S. M. Levitskii and Z. A. Plyatsok (Kiev State Univ.). Pribory i Tekh. Ekspt., 6: No. 2, 150-2(Mar.-Apr. 1961). (In Russian)

A design is given for a device using semiconductor diodes as counter elements for measuring plasma gas discharge. (R.V.J.)

31737 ON THE FORM OF OHM'S LAW IN MAGNETIC HYDRODYNAMICS. G. A. Lyubimov. Priklad. Mat. i Mekhan., 25: 611-22(July-Aug. 1961). (In Russian)

Use is made of a model of a many-component quasi-neutral medium composed of electrons, ions, and neutral atoms. On the basis of such a model a relationship is derived connecting the current density with other parameters (i.e., a generalized form of Ohm's law) in the presence of some space charge ρ_e. In addition, hypotheses and proposals are formulated and discussed which determine the form of the generalized Ohm's law, as well as the boundaries of applicability of the derived relationships. Non-dimensional parameters connected with mechanical and physical characteristics of the problem are extracted which by themselves also determine the form of Ohm's law. The different forms are examined from the point of view of their application to various concrete problems. One of these non-dimensional parameters characterizes the spiralling of an electron between two collisions. When the parameter is much less than one, the generalized form reverts to the form applicable for stationary conductors. When the parameter equals one, the form becomes the one used in the study of the flow of a conducting gas with anisotropic conduction. (TTT)

31738 A NOTE ON THE ENERGETIC PRINCIPLE IN MAGNETOHYDRODYNAMICS. K. N. Stepanov and V. V. Khomenyuk. Priklad. Mat. i Mekhan., 25: 760-3(July-Aug. 1961). (In Russian)

A theorem is proved concerning the stability of the equilibrium configuration of an ideally conducting liquid. This is done for two cases, one in which the liquid is non-viscous and the other where the liquid is viscous. It is shown that for both cases the necessary condition for the stability of the equilibrium state, $\xi = 0$ and $d\xi/dt = 0$, is that U, the internal energy, must be greater than or equal to zero. This condition holds for the viscous liquid despite the presence of viscous forces. "ξ" is the mixing and is a function of time and the position coordinates. (TTT)

31739 LINES OF THE N v SPECTRUM IN THE VISIBLE AND NEAR ULTRA-VIOLET WAVELENGTH REGIONS.

R. Hallin (Univ. of Uppsala) and T. P. Hughes. Proc. Phys. Soc.(London), 78: 201-3(Aug. 1961).

Measured wavelengths of several N v lines emitted from the toroidal gas discharge apparatus Sceptre III are given. For hydrogenic transitions they agree closely with the predictions of a polarization formula due to Edlén. Observations of 6 to 7 transitions are compared with those reported by Lukianov and Sinitsyn which, being made at higher pressures, were probably more strongly influenced by the Stark effect. The possibility of using the Stark effect in high quantum number transitions in Li sequence atoms such as C iv, N v, or O vi for density measurements is discussed briefly. (auth)

31740 A THEORY OF INCOHERENT SCATTERING OF RADIO WAVES BY A PLASMA. II. SCATTERING IN A MAGNETIC FIELD. D. T. Farley (Chalmers Univ. of Tech., Göteborg), J. P. Dougherty, and D. W. Barron. Proc. Roy. Soc. (London), A, 263: 238-58(Sept. 5, 1961).

A general expression for the frequency spectrum of radio waves scattered by random thermal fluctuations of electron density in a plasma in a magnetic field is derived. The derivation is based on the generalized Nyquist noise theorem. The result is simplified by an approximation assuming the velocity of light to be infinite. It is shown that this approximation is adequate for ionospheric applications of the theory. Next it is proved, without appealing to any approximation, that the magnetic field can never alter the total scattered signal power; it can only redistribute this power over the spectrum. Finally, the detailed shape of the frequency spectrum of the scattered signal is examined. Analytic expressions are given for certain limiting cases, but for cases of most interest, numerical methods must be used. Results of numerical calculations are shown. From these results, it can be seen that the magnetic field has a significant effect on the shape of the spectrum only if the incident radio beam is very nearly orthogonal to the magnetic lines of force. For example, for an operating frequency of 40 Mc/s, no significant magnetic effect is observed even when the beam is within 5° of orthogonality. As this angle is decreased further, however, the spectrum rapidly begins to develop spikes at Doppler shifts which are approximate multiples of the ion gyro-frequency. These spikes are quite pronounced when the beam is 2° from orthogonality. At higher operating frequencies, the beam must be proportionally closer to orthogonality to achieve the same effect. (auth)

31741 A CLASS OF EXACT SOLUTIONS OF THE MAGNETOHYDRODYNAMIC NAVIER-STOKES EQUATIONS. Ching-Sheng Wu (Princeton Univ., N. J.). Quart. J. Mech. and Appl. Math., 14: 1-19(Feb. 1961).

A class of similarity solutions of the hydromagnetic Navier-Stokes equations and Maxwell's field equations were found in spherical coordinates. The solutions may be considered as generalized Landau-Squire's jet solutions when magnetohydrodynamic interaction is present. In an attempt to solve the reduced ordinary differential system a perturbation expansion of the small parameter α was employed, where α is the ratio of kinematic viscosity to the magnetic viscosity. The physical meaning of the solutions is discussed and results of numerical calculation are also presented in tabular form. (auth)

31742 THE FINAL STAGE OF DECAY OF A LOCALIZED DISTURBANCE IN A CONDUCTING FLUID IN A UNIFORM MAGNETIC FIELD. P. G. Saffman (King's Coll., London). Quart. J. Mech. and Appl. Math., 14: 20-8(Feb. 1961).

A general localized disturbance was given to an incompressible conducting fluid of infinite extent in a uniform magnetic field, and the final stage of decay was examined for the case in which a net linear momentum was imparted to the fluid. It was found that after a sufficiently long time the velocity field is that due to the superposition of two identical viscous vortex rings, of the type found by Phillips for the corresponding problem in a non-conducting fluid, whose centers move in opposite directions along the uniform magnetic field with the Alfvén wave velocity. Some remarks are included about the decay of a turbulent wake behind a body moving through the fluid. (auth)

31743 THE DYNAMIC BEHAVIOR OF THE TUBULAR PINCH EFFECT. Günther Lehner (Institut für Plasmaphysik, Munich). Z. Naturforsch., 16a: 548-62(June 1961). (In German)

In a tubular pinch configuration the plasma cylinder is simultaneously compressed by magnetic fields radially both from the outside and from the inside. This configuration is investigated theoretically and experimentally. For the theoretical model ohmic resistivities are neglected and adiabatic compression is assumed. This theoretical model yields the times of the successive compressions of the plasma. For the experiments a capacitor bank of 40 μF and 40 kv is used. It is discharged through a vessel of 50 cm length, 10 cm I.D. and 20 cm O.D. at 10^{-2} to 10^{-1} mm of deuterium. The maximum currents are approximately 700 kamp. The half period is 4.5 μsec. Measurements of currents are made with Rogowski-coils, of magnetic fluxes with loops and of magnetic fields with probes. The time history of the intensity of a number of spectral lines is recorded. The experimental results are compared with the theory. The experimental times at which compressions occur are found to be 10% larger than the theoretical times. This discrepancy can be eliminated by the proper choice of a factor in the theory. Two oscillatory modes evolve from the linearization of the equations of the adiabatic model. These modes resemble the in and out of phase coupling of two pendulums. Due to the cylinder symmetry of the plasma configuration the in phase oscillation is excited. When the amplitude of this oscillation becomes large enough for the plasma to hit the walls, the appearence of spectral lines of impurities from the walls is observed. The intensities of these impurity-lines first decrease and then increase with increasing stabilizing longitudinal magnetic fields. The minimum of the intensities of the lines is found to lie between 500 and 1000 gauss. The initial decrease of the intensities is interpreted as an increase of the stability of the plasma, while the succeeding increase of intensities is interpreted as a consequence of the in phase oscillation. (auth)

31744 MAGNETOHYDRODYNAMIC WAVES IN CYLINDRICAL WAVE GUIDES AND IN TORUS-SHAPED RESONATORS. J. Szabo and I. Abonyi (Univ. of Budapest). Z. Physik, 163: 535-8(1961). (In German)

The magnetohydrodynamic waves of small amplitude in finite cylindrical wave guides of right angled or circular cross section were investigated. The magnetohydrodynamic waves arising in a torus were described approximately with a similar method. It was shown that in both cases longitudinal, transverse, and mixed waves can occur. (tr-auth)

31745 ON INSTABILITIES CAUSED BY INTERACTION BETWEEN CHARGED PARTICLES BEAMS AND PLASMA. Ya. B. Fainberg, V. I. Kurilko, and V. D. Shapiro. Zhur. Tekh. Fiz., 31: 633-9(June 1961). (In Russian)

The problem of convective and absolute instability in the

interactions of charged particle beams with plasma and with each other was analyzed. (R.V.J.)

31746 INSTABILITIES OF CHARGED PARTICLES BEAM IN ELECTRON PLASMA. V. S. Imshennik and Yu. I. Morosov. Zhur. Tekh. Fiz., 31: 640-9(June 1961). (In Russian)

The instability of a charged particle beam in plasma due to electron longitudinal oscillations was studied. The velocity of the particle beam is assumed to be higher than the mean thermal velocity of plasma electrons. A solution is found for the congruent distribution equation as the function of the ratio of densities and thermal velocity distribution of particle beam and plasma electrons. A spatial structure with characteristic length is developed in the system. In such a case the hydrodynamic approximation holds good. (tr-auth)

31747 OBSERVATIONS OF HYDROMAGNETIC OSCILLATIONS IN PULSE ELECTRODE-FREE DISCHARGE PLASMA. M. D. Gabovich and I. M. Mitropan (Kiev Inst. of Physics, Academy of Sciences, Ukrainian SSR). Zhur. Tekh. Fiz., 31: 676-9(June 1961). (In Russian)

Results are described of experiments which confirm the existence of radial plasma oscillations related to the ring-shaped current appearing in pulse electrode-free discharge. (R.V.J.)

31748 THE INTERACTION OF AN ELECTRON BEAM WITH A PLASMA IN A MAGNETIC FIELD. I. F. Kharchenko, Ya. B. Feinberg, R. M. Nikolaev, E. A. Kornilov, E. I. Lutsenko, and N. S. Pedenko (Khar'kov Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Tekh. Fiz., 31: 761-5(July 1961). (In Russian)

The interaction of an electron beam with a plasma in a magnetic field is investigated. The electron beam source had an energy of 5 kev and a current of 50 ma. The plasma was located in a low pressure system, 10^{-2} to 10^{-3} mm of Hg. As the beam emerged from the interaction zone (300 mm in length) its energy and high frequency oscillations were measured. The magnetic field could be raised to 2000 gauss. It was found that without prior modulation the electron beam became unstable. The extent of instability was large (up to 50%), depending on the pressure and the beam current and energy. For a previously modulated beam, f_m equal to 2530 megahertz, four narrow (a few percent) regions of instability were found to develop at magnetic fields of 410, 880, 1290, and 1815 gauss. These instabilities corresponded to electron-cyclotron frequencies equal to $\frac{1}{2}f_m$, f_m, $\frac{3}{2}f_m$, and $2f_m$. It is concluded that an electron beam injected into a plasma situated in an inhomogeneous magnetic field may acquire a sufficiently large velocity perpendicular to the magnetic field and beam instabilities cannot be excluded. (TTT)

31749 ON THE TRANSIENT RADIATION OF CURRENTS DURING THE PASSAGE THROUGH A PLASMA BOUNDARY. V. N. Tsytovich (Lebedev Inst. of Physics, Moscow). Zhur. Tekh. Fiz., 31: 766-74(July 1961). (In Russian)

The question of transient radiation of currents passing through the boundary division of a plasma and vacuum is examined. The calculation is made for a linear current crossing the boundary with a constant velocity and a direction parallel to the boundary. The plasma is located in a constant magnetic field perpendicular to the boundary. In the ultrarelativistic case all radiations induced at the boundary, in the case of coherency, play a role only in the longitudinal dimensions of the current flow. In the case of coherency these dimensions are less than the minimum emitted wave length, independent of the energy and proportional to γ, the relativistic factor. The intensity of the radiation is then proportional to the square of the current strength and the coherency effect during the passage of the boundary can be greater than the effect during movement inside the medium. Further, the work force is examined for a current in the case of a dividing region in which the plasma density falls off linearly with distance. It is shown that if the boundary region is sufficiently large the radiation intensity decreases sharply and subsequently disappears. This despite the fact that the work force converges to a finite limit corresponding to the energy of the macroscopic renormalization of the mass. (TTT)

31750 THE INFLUENCE OF AN OUTER MAGNETIC FIELD ON THE PLASMA BOUNDARY LAYER. E. I. Andriankin and Yu. S. Sayasov. Zhur. Tekh. Fiz., 31: 775-80(July 1961). (In Russian)

The influence of an external magnetic field on the laminar boundary layer in a plasma is investigated. It is shown that under a sufficiently small temperature difference between the accumulating gas and the boundary of a body situated in the gas flow there can exist flow conditions such that the friction on the body surface increases monotonically with the increase in H. "H" is the component of the magnetic field perpendicular to the velocity of the oncoming flow. This increase under sufficiently high H becomes linear in character. (TTT)

31751 THEORY OF A NEW PLASMOID. A. A. Vlasov (Moscow State Univ.). Zhur. Tekh. Fiz., 31: 785-96(July 1961). (In Russian)

An equation of state is derived for a three-dimensional plasma consisting of one type of charged particles held together by internal and external forces. An external magnetic field acting on a cylindrical beam of atomic nuclei with a drift velocity through the magnetic field causes the formation of agglomerates which are called plasmoids. The derived equation of state is: $\Theta = (m\, w_L^2\, D^2/4)\, [1/\psi(\lambda)]$ where Θ is the temperature, w_L Larmor frequency, D radius of the cylinder, and m the particle mass. $\psi(\lambda) = \int_0^\infty x\, e^{-x^2+\varphi} dx$, where $\lambda = 2\, w_0^2/w_L^2$, $x = m\, w_L^2\, r^2/2$, w_0 is the Langmuir frequency and r is the distance coordinate. "ψ" is a special function depending on x and λ. The condition for a plasmoidal state is that $\psi(\lambda) < \infty$. This is true as long as $\lambda < 4$. (TTT)

31752 THE ACHIEVEMENT OF A HIGH DENSITY PLASMA BY MEANS OF A HOT CATHODE DISCHARGE IN A MAGNETIC FIELD. V. E. Golant, N. I. Orlov, and L. P. Pakhomov (Leningrad Inst. of Physics and Tech.). Zhur. Tekh. Fiz., 31: 797-801(July 1961). (In Russian)

Results are presented concerning the investigation of the discharge of a hot cathode in a magnetic field. A steady discharge in hydrogen was obtained with pressures greater than 5×10^{-4} mm of Hg. Under these conditions is an inhomogeneous magnetic field the concentration of the plasma exceeds 10^{14} cm^{-3} with currents greater than 5 amperes. (TTT)

31753 SOME EXPERIMENTS ON THE STATIONARY FLOW OF PLASMA IN A HOMOPOLAR. M. F. Shirokov, E. P. Vaulin, and N. A. Chesnokov (Moscow Aviation Inst.). Zhur. Tekh. Fiz., 31: 802-5(July 1961). (In Russian)

The stationary flow is studied for an ionized gas in a homopolar device under a pressure of 4×10^{-1} mm of Hg and in an external magnetic field of 250 oersteds. Experimental results are in satisfactory agreement with formulae

for turbulent and laminar plasma flows; but because the Reynolds number is less than 2.5 the flow must be taken to be laminar. (TTT)

31754 ON THE INVERSION OF INFLUENCE IN MAGNETOHYDRODYNAMICS. L. A. Vulis and P. L. Gusika (Kazakh State Univ., Alma-Ata, Kazakh SSR). Zhur. Tekh. Fiz., 31: 806-18(July 1961). (In Russian)

The investigation shows the applicability of the law of the inversion of action to a stationary quasi-single-valued flow of a conducting gas in the presence of the influence of electromagnetic phenomena. It is shown that in the general case the "inversion of action" is related to the general Mach number $\overline{M} = u/\tilde{a}$, where u is the flow velocity and $\tilde{a}$ is the total velocity of the magnetosound waves. When the magnetic Reynolds number, Re_m is much greater than 1, then $\tilde{a} \approx \sqrt{a^2 + (\mu H^2/\rho)}$, where a is the speed of sound and μ is the magnetic permeability, H the field strength, and ρ is the density of the gas. When Re_m is much less than 1, then $\tilde{a} \approx a$. (TTT)

31755 HYDROGASEOUS ANALOGY IN MAGNETOHYDRODYNAMICS. L. A. Vulis and P. L. Gusika (Kazakh State Univ., Alma-Ata, Kazakh SSR). Zhur. Tekh. Fiz., 31: 819-23(July 1961). (In Russian)

The applicability of the hydrogaseous analogy to the investigation of magnetohydrodynamical flows of conducting gases is demonstrated. The analogy can be used in a number of magnetic gasodynamical problems, such as, the flowing by a body of a plane stream and the flow in a magnetohydrodynamical boundary layer. It is shown that when the magnetic pressure is much greater than the hydrodynamical pressure then the specific heat under constant pressure, C_p, divided by the specific heat under constant volume, C_v, equals two. Such a case is interesting in connection with hydrodynamical processes in plasmas. When C_p/C_v is not equal to two the analogy holds qualitatively, but, as in ordinary gasodynamics, can be used in quantitative relations by means of the appropriate conversion. (TTT)

31756 BIBLIOGRAPHY ON RESEARCH ON CONTROLLED THERMONUCLEAR FUSION. (International Atomic Energy Agency, Vienna). 1961. 266p. STI/DOC/40(IAEA)

A list of references on research on controlled thermonuclear fusion is presented. The bibliography contains 2904 references to works published between January 1955 and December 1960. The references are arranged in alphabetical order by author. A subject index is included. (M.C.G.)

31757 AN ARRANGEMENT AND PROCESS FOR GENERATING AND MAINTAINING VERY HIGH TEMPERATURES SUFFICING FOR THE PRODUCTION OF NUCLEAR REACTORS. (to Max-Planck-Gesellschaft zur Förderung der Wissenschaften e.V.). British Patent 877,930. Sept. 20, 1961.

A process is outlined for producing temperatures on the order of 10^7°C for thermonuclear reactions. In this process, a toroidal reaction chamber with a closed, non-alternating magnetic field of ≥ 10,000 gauss is filled with D_2 and/or T_2 at 10^{-3} mm Hg. A voltage is then applied to ionize the fuel and to raise its temperature, and a-c is supplied to some of the toroidal coils with a frequency equal to the gyro-frequency (~ 50 Mc) to produce more heat. The strength of the main magnetic field is increased rapidly from 10,000 to ~ 50,000 gauss to provide heating by compression. The fuel is then set in motion by a moving magnetic field, and the main field is modulated near or higher than the collision frequency. Energy is extracted as electric current in coils surrounding the toroid. (D.L.C.)

31758 IMPROVEMENTS IN OR RELATING TO PLASMA INJECTION DEVICES. (to Compagnie Generale de Telegraphie Sans Fil). British Patent 878,337. Sept. 27, 1961.

A plasma injection device intended for use with a particle confining apparatus is described. The injector includes means for mixing ions of high energy and electrons before injection into the confinement, wherein the high energy ions and the electrons form two coaxial beams. Means are provided for deflecting at least one of the beams towards the other beam for intermingling. Two embodiments of the injector are described, in one the electron beam converges toward the ion beam and in the other the ion beam diverges toward the electron beam. (N.W.R.)

31759 REACTORS. L. Spitzer, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,002,912. Oct. 3, 1961.

Thermonuclear reactors, methods, and apparatus are described for controlling and confining high temperature plasma. Main axial confining coils in combination with helical windings provide a rotational transform that avoids the necessity of a figure-eight shaped reactor tube. The helical windings provide a multipolar helical magnetic field transverse to the axis of the main axial confining coils so as to improve the effectiveness of the confining field by counteracting the tendency of the more central lines of force in the stellarator tube to exchange positions with the magnetic lines of force nearer the walls of the tube. (AEC)

31760 APPARATUS FOR MINIMIZING ENERGY LOSSES FROM MAGNETICALLY CONFINED VOLUMES OF HOT PLASMA. Richard F. Post (to U. S. Atomic Energy Commission). U. S. Patent 3,003,080. Oct. 3, 1961.

An apparatus is described for controlling electron temperature in plasma confined in a Pyrotron magnetic containment field. Basically the device comprises means for directing low temperature electrons to the plasma in controlled quantities to maintain a predetermined optimum equilibrium electron temperature whereat minimum losses of plasma ions due to ambipolar effects and energy damping of the ions due to dynamical friction with the electrons occur. (AEC)

31761 ROTATING PLASMA DEVICE. Keith Boyer, Jay E. Hammel, Conrad L. Longmire, Darragh E. Nagle, Fred L. Ribe, and James L. Tuck (to U. S. Atomic Energy Commission). U. S. Patent 3,004,767. Oct. 24, 1961.

A method and device are described for obtaining fusion reactions. The basic concept is that of using crossed electric and magnetic fields to induce a plasma rotation in which the ionized particles follow a circumferential drift orbit on which a cyclotron mode of motion is superimposed, the net result being a cycloidal motion about the axis of symmetry. The discharge tube has a radial electric field and a longitudinal magnetic field. Mirror machine geometry is utilized. The device avoids reliance on the pinch effect and its associated instability problems. (AEC)

31762 ION GUN. Raphael A. Dandl (to U. S. Atomic Energy Commission). U. S. Patent 3,005,931. Oct. 24, 1961.

An ion gun is described for the production of an electrically neutral ionized plasma. The ion gun comprises an anode and a cathode mounted in concentric relationship with a narrow annulus between. The facing surfaces of the rear portions of the anode and cathode are recessed to form an annular manifold. Positioned within this manifold is an annular intermediate electrode aligned with the an-

nulus between the anode and cathode. Gas is fed to the manifold and an arc discharge is established between the anode and cathode. The gas is then withdrawn from the manifold through the annulus between the anode and cathode by a pressure differential. The gas is then ionized by the arc discharge across the annulus. The ionized gas is withdrawn from the annulus by the combined effects of the pressure differential and a collimating magnetic field. In a 3000 gauss magnetic field, an arc voltage of 1800 volts, and an arc current of 0.2 amp, a plasma of about 3×10^{11} particles/cc is obtained. (AEC)

31763 NEUTRON SOURCE USING MAGNETIC COMPRESSION OF PLASMA. Warren E. Quinn, William C. Elmore, Edward M. Little, Keith Boyer, and James L. Tuck (to U. S. Atomic Energy Commission). U. S. Patent 3,006,835. Oct. 31, 1961.

A fusion reactor is described that utilizes compression and heating of an ionized thermonuclear fuel by an externally applied magnetic field, thus avoiding reliance on the pinch effect and its associated instability problems. The device consists of a gas-confining ceramic container surrounded by a single circumferential coil having a shape such as to produce a magnetic mirror geometry. A sinusoidally-oscillating, exponentially-damped current is passed circumferentially around the container, through the coil, inducing a circumferential current in the gas. Maximum compression and plasma temperature are obtained at the peak of the current oscillations, coinciding with maximum magnetic field intensity. Enhanced temperatures are obtained in the second and succeeding half cycles because the thermal energy accumulates from one half cycle to the next. (AEC)

Shielding

31764 (ORNL-3178) LID TANK SHIELDING FACILITY MEASUREMENTS BEHIND THE ML-1 MOCKUP. A. D. MacKellar, L. Jung, D. R. Mathews, F. J. Muckenthaler, J. M. Miller, and N. K. Sowards (Oak Ridge National Lab., Tenn.). Sept. 20, 1961. Contract W-7405-eng-26. 52p.

An experimental evaluation of the shield design for the ML-1 mobile reactor was made at the Lid Tank Shielding Facility. Thermal-neutron fluxes, fast-neutron dose rates, and gamma-ray dose rates were measured behind slab mockups of the basic shield design and a number of possible variations. The designs embodied various combinations of lead, Hevimet, stainless steel, boral, water, and aqueous solutions of ammonium pentaborate at two concentrations. The after-shutdown decay characteristics of the basic design were determined, and data were obtained from a fairly accurate mockup of the stainless steel plenum and gas duct typical of the top and bottom regions of the ML-1 shield. Analysis of results and application to the final shield design are not reported. (auth)

31765 SHIELDING NEUTRON SOURCES USED IN INDUSTRY. Mircea Oncescu and Ionel Apostol (Inst. of Nuclear Physics, Bucharest). Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz. Studii cercetări fiz., 12: No. 1, 103-13(1961). (In Rumanian)

A simple theoretical calculation is developed for neutron source shielding. The calculations consider neutron attenuation and γ emission resulting from radiative capture. Shields made of paraffin and of paraffin mixed with borax are calculated for Po – Be point sources. (tr-auth)

31766 SHIELDING OF A THERMAL NEUTRON FLUX WITH MAXWELL VELOCITY DISTRIBUTION WITH BORAL. J. Stickforth (Fried. Krupp Widia-Fardik, Essen). Nukleonik, 3: 109-10(July 1961). (In German)

In order to obtain the permeability of boral to thermal neutrons with a Maxwell velocity distribution, the exponential attenuation law must be averaged with the distribution function of the Maxwell flux. A power series development is derived for the permeability, and a numerical example is given. (J.S.R.)

31767 IMPROVEMENTS IN AND RELATING TO BIOLOGICAL AND THERMAL SHIELDS FOR NUCLEAR REACTORS. Paul Heinz, Walter Wolff, and Alfred John Joyce (to English Electric Co., Ltd.). British Patent 877,383. Sept. 13, 1961.

A biological and thermal shield is designed for nuclear reactors. The shield is constructed of concrete in two parts one within the other with a gap between the two parts, the gap forming a coolant passage. (D.L.C.)

31768 NEUTRON-ABSORBING MATERIAL. Angel Alberto Blanco (to Imperial Chemical Industries Ltd.). British Patent 878,465. Sept. 27, 1961.

A radiation shield is described which is suitable for use in reactors. The shield consists of discrete chips of a solid material (polyethylene or a cured resin) containing at least 3% by weight of hydrogen and having embedded therein particles of boron carbide of other neutron-absorbing material. The chips are disposed in a matrix of a material (water, silicone, or mineral oil) containing at least 3% hydrogen. The shield also contains lead or a lead compound or other material capable of absorbing gamma radiation. (N.W.R.)

Theoretical Physics

31769 (JINR-D-776) ON MEANING OF GAUGE INVARIANCE. V. I. Ogievetskii (Ogievetski) and I. V. Polubarinov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 9p.

A role of the gauge invariance is analyzed. Such an invariance guarantees that the given vector field, of electromagnetic of Yang-Mills kind, describes spin 1 only. It is shown that the requirement of the gauge invariance cannot be a principle for obtaining nontrivial interactions and for deducing the existence of any vector fields. (auth)

31770 ON STATIC SOLUTIONS IN GENERAL RELATIVITY. P. Olijnychenko (Inst. of Physics, Madrid). Nuovo cimento (10), 21: 391-4(Aug. 1, 1961). (In English)

The solution with cylindrical symmetry given by Weyl is examined by direct calculation of R_{ik}. It is concluded that Weyl's variational method is insufficient and that there is no static solution for his assumed form of T^{ik}. This conclusion is generalized for any distribution of matter. (auth)

31771 DEFINITION OF UNIFORM ACCELERATION AND ITS CONFORMAL INVARIANCE. Vachaspati and L. M. Bali (Univ. of Lucknow, India). Nuovo cimento (10), 21: 442-58(Aug. 1, 1961). (In English)

The equation defining uniform acceleration of a particle in special relativity, namely $(1 - u^2)u'' + 3(uu')u' = 0$, where u is the velocity and primes denote differentiation with respect to time, is shown to be equivalent to (i) $\dot{v}_\mu = Kv_\mu$, $\mu = 0, 1, 2, 3$, where v_μ is the four-velocity, dots denote differentiation with regard to the proper time τ, and K is a constant. On integration this gives (ii) $v_\mu = \alpha_\mu \exp[\lambda\tau] + \beta_\mu \exp[-\lambda\tau]$ and (iii) $x_\mu - \xi_\mu = (1/\lambda)\{\alpha_\mu \exp[\lambda\tau] - \beta_\mu \exp[-\lambda\tau]\}$ where $\lambda = \sqrt{K}$ and α_μ, β_μ, ξ_μ are integration constants. Three-dimensional forms of these equations are given. The

invariance of these equations is examined and it is shown that under the infinitesimal conformal transformations of the coordinates $\delta x_\mu = (ax)x_\mu - (1/2)\, x^2 a_\mu$, $[(ax) = a^\alpha x_\alpha]$, they are invariant provided K, ξ_μ, α_μ, and β_μ transform according to $\delta K = -2K(a\xi)$, $\delta\xi_\mu = (a\xi)\xi_\mu - (1/2)\xi^2 a_\mu + (1/K)[(1/2)a_\mu - 2C_\mu]$, $\delta\alpha_\mu = (\alpha a)\xi_\mu - (\alpha\xi)a_\mu$, and $\delta\beta_\mu = (\beta a)\xi_\mu - (\beta\xi)a_\mu$, with $C_\mu = (a\beta)\alpha_\mu + (a\alpha)\beta_\mu$. Since the transformation law for ξ_μ is inhomogeneous, it follows that the constants ξ_μ cannot be taken zero, and that neither K, α_μ, nor β_μ are absolute constants. It is interesting that equation (i) for V_μ is invariant only if it is considered together with its integral (ii); in turn, (ii) is invariant only if it is considered together with its integral (iii). Taken alone, neither (i) nor (ii) are conformally invariant, but (iii) is. (auth)

31772 A NATURAL BOUNDARY OF THE SCATTERING AMPLITUDE ON AN UNPHYSICAL SHEET. P. G. O. Freund and R. Karplus (Universität, Vienna). Nuovo cimento (10), 21: 519-23(Aug. 1, 1961). (In English)

The scattering amplitude has a two-sheeted branch point at zero kinetic energy. It is shown that the amplitude on the second (unphysical) sheet has a natural boundary that terminates at zero total energy. (auth)

31773 ON A MATHEMATICAL PROBLEM ENCOUNTERED IN QUANTUM FIELD THEORY. R. Omnès (Centre d'Etudes Nucléaires, Saclay, France). Nuovo cimento (10) 21: 524-30(Aug. 1, 1961). (In English)

The problem of determining a unitary analytic function, whose discontinuity on a cut is known, is reduced to the problem of solving a Fredholm equation. This method leads to much simpler and more physically transparent results than the N/D method. The connection between the two methods is elucidated. An ambiguity in the solution is displayed. The resulting form gives an insight into the structure of the s* matrix under the inelastic threshold. (auth)

31774 ANOMALOUS THRESHOLDS OF REACTION AMPLITUDES. P. G. O. Freund and R. Karplus (Universität, Vienna). Nuovo cimento (10), 21: 531-40(Aug. 1, 1961). (In English)

Anomalous thresholds of reaction amplitudes are studied without recourse to a partial wave expansion. It is shown that the behavior of the amplitudes is quite similar to that of the partial wave projections, even though the Legendre series does not converge near the anomalous threshold. (auth)

31775 ELECTROMAGNETIC SOURCES IN GENERAL RELATIVITY THEORY. Thomas R. Waite (Atomics International, Canoga Park, Calif.). Phys. Rev., 123: 1888-91(Sept. 1, 1961).

The simplest, most direct method of unifying Maxwell's theory of electromagnetism and Einstein's theory of gravitation was formulated by Rainich in 1925. That theory applies only to charge-free space. However, in regions of space in which the electromagnetic field invariant corresponding to $E \cdot B$ vanishes, the two sets of Maxwell's equations are independent for Rainich's unified theory. The Rainich theory may be modified to allow for nonvanishing charge and current density in such regions. The electromagnetic sources and fields obey Maxwell-Lorentz theory and the electromagnetic matter-energy obeys the laws of Einstein's general relativity theory. The necessary and sufficient conditions which must be imposed on the metric tensor and its derivatives in order to assure the existence of a unique antisymmetric tensor obeying the Maxwell-Lorentz laws in the presence of charges and currents are derived. (auth)

31776 ANALYTICITY OF AMPLITUDES AND SEPARABLE POTENTIALS. A. N. Mitra (Univ. of Delhi). Phys. Rev., 123: 1892-5(Sept. 1, 1961).

Expressions for the partial scattering amplitudes from nonlocal separable potentials are written in the form of dispersion relations. These relations are automatically expressible in the N/D form discussed by Chew and Mandelstam. Criteria for "acceptable" separable potential shapes are discussed. The relation between "local" and separable potentials is clarified with the help of a concrete potential shape which conforms to the above criteria. With such a potential shape the physical meaning of the "range of the interaction" in terms of separable potentials becomes clearer. As an elementary application of such "analytic" potentials, the low-energy 2-body parameters are evaluated. (auth)

31777 SUBTRACTIONS IN DISPERSION RELATIONS. Masao Sugawara and Akira Kanazawa (Purdue Univ., Lafayette, Ind.). Phys. Rev., 123: 1895-1902(Sept. 1, 1961).

It is proved that if an analytic function f(z) has singularities only on the real axis and is bounded in magnitude at infinity by a finite but arbitrary power of z, then f(z) has essentially the same limits everywhere at infinity. This theorem enables one to express the contribution from the infinite circle of the Cauchy contour integral in terms of the boundary values of f(z) at infinity along only one of the cuts extending to infinity. The exact dispersion relation is thus determined. As examples, the forward and double pion-nucleon dispersion relations are derived, assuming that the total cross section approaches a finite limit at infinite energy. The subtractions are determined completely by the theorem. (auth)

31778 ELECTRIC DIPOLE APPROXIMATION AND THE CANONICAL FORMALISM IN ELECTRODYNAMICS. Melvin Schwartz (Syracuse Univ., N. Y.). Phys. Rev., 123: 1903-8(Sept. 1, 1961).

The electric dipole approximation is used to study the problem of finding commuting solutions of coupled equations of motion. It is pointed out that for a charged particle in an external radiation field, the solutions of the coupled equations cannot be considered independent in the sense of commuting with one another if the homogeneous solutions are assumed to have the commutation properties of uncoupled variables. The case of a charged free particle and a charged harmonic oscillator in an external radiation field is explicitly treated. It is indicated that for a retarded (advanced) self-field, the free particle fits into a canonical formalism while the oscillator does not. For a stationary self-field, both the free particle and the oscillator fit into a canonical formalism. It is shown that the Fourier transforms of the configuration space solutions (based on e^{ikx} and $e^{i\omega t}$) do not exist. In the latter connection, it is pointed out that earlier treatments of the oscillator by Sokolov and Tumanov and Norton and Watson contain misleading results as a consequence of their using Fourier transforms. (auth)

31779 THE METHODS OF GROUP THEORY IN THE QUANTUM MECHANICS OF SOLID BODIES (SYMMETRICAL SPACES). A. W. Sokołow and W. P. Szyrokowski. Postępy Fizyki, 12: 257-89(1961). (In Polish)

The basic elements of space and vector groups are reviewed, and the works of Seitz, Smulochowski and Wigner are introduced. Analytical operations basic to an understanding of the quantum mechanics of solid bodies are developed and relevant relationships are derived. These are then applied to problems in determining the energy states of solid bodies, the energy states of electrons in symmetrical fields of cubic crystals and the effect on the energy

levels when spin is considered. Finally the concept of inverse time is introduced for spinless particles and amplified via the Pauli matrices for particles of spin 1/2. (TTT)

31780 UNIFIED GRAVITATIONAL AND ELECTROMAGNETIC WAVES. P. C. Vaidya (Gujarat Univ., Ahmedabad, India). Progr. Theoret. Phys. (Kyoto), 25: 305-14 (Mar. 1961). (In English)

Starting with a very general form of the nonsymmetric tensor g_{ik} expressed in a coordinate system chosen to yield wave solutions, a scheme is developed for deriving rigorous solutions of Einstein field equations, which solutions describe the flow of unified gravitational and electromagnetic radiation. Several solutions are derived, giving waves with two-dimensional symmetry. It is found that solutions describing gravitational and electromagnetic waves, obtained in the general theory of relativity with the help of an energy momentum tensor, can be derived in exactly the same form from the geometrical theory of the unified law of inertia. (auth)

31781 QUANTUM STATISTICS OF INTERACTING ELECTRON GAS IN A STRONG MAGNETIC FIELD. Hiroshi Ichimura and Setsuko Tanaka (Tokyo Inst. of Tech.). Progr. Theoret. Phys. (Kyoto), 25: 315-26(Mar. 1961). (In English)

The quantum statistical mechanical propagator is calculated by using the free-electron eigenfunction in a magnetic field. This form of the propagator is appropriate for the treatment of oscillatory behavior of magnetic properties of the interacting electron gas. As a tentative application of this method, the effect of the Coulomb interaction between electrons on the de Haas-van Alphen effect is discussed. (auth)

31782 INTEGRAL REPRESENTATION OF ABSORPTIVE PART OF VERTEX FUNCTION. Kunio Yamamoto (Osaka Univ.). Progr. Theoret. Phys. (Kyoto), 25: 361-8 (Mar. 1961). (In English)

On the basis of Lorentz invariance, local commutativity, and mass spectral conditions, it is shown that the absorptive part of the vertex function $A(z_1, z_2, \sigma^2)$ has an integral representation in the form $A(z_1, z_2, \sigma^2) = \int dm_1 dm_2 dm_3 \varphi(\sigma, m_1, m_2, m_3) A^P(z_1, z_2, \sigma^2; m_1, m_2, m_3)$, provided that z_1 and z_2 are real negative, where A^P is the absorptive part of the lowest order perturbation theory and m is the mass of the virtual particle. The vanishing region of the weight function φ is determined by the mass spectral conditions. As an immediate consequence of this representation, the usual proof of the dispersion relation of the vertex function is given. If the information derivable from perturbation theory is added to this representation, it can be shown that the dispersion relation always holds and that the threshold is not lower than the lowest threshold of the vertex function in the lowest order perturbation theory which satisfies the mass spectral condition. It is conjectured that the nonvanishing region of the weight function is narrowed by introducing the conservation of nucleon number. (auth)

31783 PHASE SHIFT AND IDENTITIES IN QUANTIZED FIELD THEORY. Shûkô Azuma (Fukushima Univ., [Japan]). Progr. Theoret. Phys. (Kyoto), 25: 381-403(Mar. 1961). (In English)

Certain basic relations between phase shifts and the energy spectra are pointed out and illustrated by examples. Several applications of these relations are considered: a determinant form for the S-matrix is found; n-body forces in the static pair-coupling theory are evaluated; some properties of the g-derivative of the phase shift are discussed; and a covariant method for the construction of nuclear force is proposed. (auth)

31784 DISPERSION RELATIONS AND HIGH ENERGY LIMITS IN QUANTUM FIELD THEORY. [PART] II. Seiya Aramaki (Tokyo Univ. of Education). Progr. Theoret. Phys. (Kyoto), 25: 404-10(Mar. 1961). (In English)

The lower and upper bounds of the high energy limit of pion-nucleon forward scattering amplitudes are investigated. The former is studied using available experimental data, and it is found that at least one subtraction is necessary in the dispersion relations. The latter can be determined under requirement that the forward amplitude has no zero in the complex energy plane. Some discussions are given to the problem of the high-energy behavior in quantum field theories. (auth)

31785 TRANSITION AMPLITUDES IN PERTURBATION THEORY AND DYSON'S INTEGRAL REPRESENTATION. Gaku Konisi and Kunio Yamamoto (Osaka Univ.). Progr. Theoret. Phys. (Kyoto), 25: 461-6(Mar. 1961). (In English)

It is shown that Dyson's integral representation for the matrix element of a causal commutator, between the vacuum and an arbitrary state, is closely related to the transition amplitude in the lowest order of perturbation. This relation is used to clarify physical meanings of the parameters of integration. A particular integral representation for the absorptive parts of vertex functions may be derived from this relation as an example. The relation can be applied also for the absorptive parts of scattering amplitudes, in which case a more complicated connection with perturbation theory is obtained than is the case with vertex functions. (auth)

31786 A NOTE ON THE TREATMENT OF BOUND STATE PROBLEM. Shigeo Sato (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 25: 512-13(Mar. 1961). (In English)

An eigenfunction is derived that furnishes a relativistic generalization of the Schrödinger equation, for the bound states of a two-particle system. The function reduces to the ordinary Schrödinger equation in the nonrelativistic limit. (T.F.H.)

31787 LOCAL INVARIANCE AND THE THEORY OF A COMPENSATING FIELD. V. B. Adamskii. Uspekhi Fiz. Nauk, 74: 609-26(Aug. 1961). (In Russian)

It is characteristic of contemporary physical theories that the equations and dynamic variables referring to a phenomenon are invariant to some type of transformations, that is, the parameters determining a transformation are independent at each point of space-time. However, it is necessary to introduce a new compensating force which satisfies the invariance under the conditions of independence. Thus, an electromagnetic field is introduced if it is assumed that the phase property is a function of the space coordinates and time. The general thoery of local invariance is discussed and it is shown that if there is a field whose action is invariant with respect to a group of transformations depending on one or more of the parameters α_i, it is necessary to introduce a compensating field on making a transformation where the new parameters depend on the coordinates of α_i. The conservation of charge in reactions between heavy particles (barions) and the corresponding phase transformation is discussed. It is pointed out that here there is a complete analogy with the conservation of electrical charge. Yang and Mills have shown that it is necessary to postulate the existence of a 12-component, B-field if invariance is assumed with respect to local inde-

pendent transformations in isotopic space. The existence of an intermediate meson in weak interactions is examined from the point of view of local invariance. The concept of the invariance of a compensating charge field is applied to the theory of weak interactions. It is shown that it is necessary to introduce a compensating gravitational field in order to conserve invariance, even when a curvo-linear set of coordinates is used. The rest mass does not enter into these compensating fields, and hence it would seem that these compensating fields are completely analogous to coulombic fields. (TTT)

31788 ELECTRODYNAMICS OF CONTINUOUS MEDIA. L. D. Landau and E. M. Lifshitz. Volume 8 of Course of Theoretical Physics. Translated from the Russian by J. B. Sykes and J. S. Bell. Oxford, Pergamon Press and Reading, Massachusetts, Addison-Wesley Publishing Company, Inc., 1960. 425p.

An exposition is presented of the macroscopic electric, magnetic, and electromagnetic properties of matter. The electrostatics of conductors and dielectrics are studied. Phenomena involving constant current or magnetic field are discussed. Attention is devoted to ferromagnetism, superconductivity, magnetofluiddynamics, the passage of fast particles through matter, and the diffraction of x rays in crystals. Quasi-static electromagnetic fields are examined. The equations, propagation, fluctuations, and scattering of electromagnetic waves in matter are investigated. (T.F.H.)

REACTOR TECHNOLOGY

General and Miscellaneous

Refer also to abstracts 30348, 30351, and 30817

31789 (61GL23) REACTOR FRETTING: SOME CAUSES AND METHODS OF CONTROL. R. E. Lee, Jr. (General Electric Co. General Engineering Lab., Schenectady, N. Y.). Jan. 12, 1961. 10p.

A discussion is presented of components engaged in relative sliding which involves small slip amplitudes of the order of several mils to 0.100 inch. This type of sliding is usually known as fretting or fretting corrosion. The fretting mechanism is examined and methods of control are outlined. (J.R.D.)

31790 (AD-259723) THEORETICAL ANALYSIS OF A CYLINDRICAL FAST REACTOR CONTAINING CONCENTRIC ANNULAR VOIDS (thesis). James H. Mann (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio). Mar. 1961. 107p. (GNE/Phys/61-11).

The first engineering estimates for a proposed fast, pulse-type reactor are presented. The reactor consists of a layered structure of thin-walled concentric cylinders composed of uranium and 10% by weight molybdenum. Design requirements and the advantages of the proposed design over existing facilities are discussed. The Multigroup Asymptotic Transport Method was used to determine the material buckling and clean-cold critical mass of a solid, bare, cylindrical cylinder, which serves as a base for the proposed design. Using a method based on the maximum thermal expansion that occurs throughout the operating temperature ranges, the optimum size of the shells and coolant channel voids were determined. A central channel, to provide a means for pulsing the assembly, and the annular cooling voids were introduced into the core and the effects were analyzed. Then, a new critical mass was computed. Performance characteristics during a pulsing cycle were computed, based on the maximum allowable temperature rise, and compared to the performance of Godiva II. In all cases, the proposed facility indicated a decided improvement over the existing prototypes in its operating capabilities. This analysis appeared to indicate that the proposed design is feasible in addition to advancing the "state of the art" as it exists in pulsing facilities. (auth)

31791 (AEEW-R-76) THE EFFECT OF NON-UNIFORM FUEL ROD TEMPERATURES ON EFFECTIVE RESONANCE INTEGRALS. A. Reichel (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Establishment, Winfrith, Dorset, England). June 1961. 53p.

The effective resonance integral for heterogeneous lattices can be reduced to the effective resonance integral for an equivalent homogeneous system with a fairly well defined error depending on lump size and geometry. An investigation was made of the effect of a radial parabolic temperature variation in cylindrical lumps on the equivalent homogeneous effective resonance integral. Also determined is the equivalent uniform temperature to be taken in the usual formula to allow for non-uniform fuel rod temperature. This effective temperature is found to be: $T_{eff.} = T_s + (4/9)(T_c - T_s)$, where T_s and T_c are the surface and central temperatures of the lump. (auth)

31792 (ANL-6385) POWER-TO-VOID TRANSFER FUNCTIONS. Helge Christensen (Argonne National Lab., Ill.). July 1961. Contract W-31-109-Eng-38. 148p.

Variations in the distribution of steam bubble, the "void" distribution, in a boiling channel as a function of changes in heating power were studied. A rectangular test tube, of 1.11 × 4.44-cm cross section and 127-cm height, was inserted in a forced-circulation pressure loop. The tube was heated by passing an a-c current through the tube walls. A power oscillator was built which could give a 10% peak-to-peak sinusoidal power modulation at any frequency in the interval from 0.01 to 10 cps. Variations in the volume fraction of steam were observed by means of a gamma densitometer built for the purpose. Accurate void profiles could be taken by traversing the test channel vertically and horizontally. With the void detector stationary at a given height, the amplitude and phase delay of the steam void variations were measured in the frequency range mentioned. The signal from the gamma detector was passed to a harmonic analyzer built for the experiment. This instrument could pick out the void variations coherent with the power variation in the presence of much greater random signal variations caused by the boiling process. The frequency response of steam void was measured at 4 different pressures ranging from 27.2 to 68 atms, at conditions comparable to those in pressurized boiling water reactors. Void phase and void amplitude are plotted as functions of frequency, and the data are also presented in tables. The most important result of the experiments is to show that the void response falls off at a frequency that is much lower than that predicted by theoretically derived power-to-void transfer functions used previously in reactor calculations. Also, the void amplitude in the lower part of the channel was larger than expected. By taking into account the pressure changes in the channel caused by the power variations, an expression was derived for the power-to-void transfer function that could be fitted very well to the data. A constant, associated with the completeness of the mixing in the direction perpendicular to flow, had to be chosen in order to fit properly the break frequency in the amplitude curve. (auth)

31793 (APAE-Memo-295) ECONOMIC ANALYSIS OF REPLACEMENT CORES FOR SM AND PM TYPE REACTORS. A. S. Wilder (Alco Products, Inc., Schenectady, N. Y.). Oct. 5, 1961. Contract AT(30-1)-2639. 14p.

An economic analysis is presented for the fabrication of replacement cores for SM and PM type reactors, including analysis of various core types and core fabrication technologies. The analysis indicates that major savings are possible by utilizing Type 3 cores (40-mil plates, 25 wt % UO_2, welded assembly) in all SM and PM type reactors, and that significant savings are possible by multiple core procurement and reprocessing, and relaxation of cobalt and tantalum requirements in Type 347 stainless steel. (auth)

31794 (BLG-40) A METHOD FOR REPLACING A REGION OF A REACTOR BY ANOTHER REGION, GEOMETRICALLY SIMPLER. H. Dopchie (Brussels. Centre d'Etude de l'Energie Nucleaire). Apr. 17, 1958. 14p.

In many problems, where the diffusion equations are used, it is useful to replace a region, of a reactor for instance, by another geometrically simpler (usually circular). This method is frequently applied, in the calculations of a cell of a heterogeneous reactor, or of control

rod efficiency. A way of evaluating the boundary conditions of the simplified region is presented, based on the equalization of averaged albedos. This procedure is rather fast if one possesses a code for computer calculations, which gives the albedos, or a quantity directly related to them (admittances). (auth)

31795 (CEA-1967) CALCUL DU FACTEUR D'UTILISATION THERMIQUE DANS UNE CELLULE FORMEE D'UN NOMBRE QUELCONQUE DE MILIEUX CONCENTRIQUES. (Calculation of the Thermal Utilisation Factor in a Cell Made up of a Given Number of Concentric Media). Albert Amouyal, Pierre Benoist, and Christian Guionnet (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1961. 32p.

The thermal utilization factor is calculated for a cylindrical cell containing a number of concentric media, some of which may be empty. A collision-by-collision method is used in all but the peripheral medium, which may be treated by a theory of controlled diffusion. A matrix formulation of the method is presented. (auth)

31796 (CEA-1979) LES METHODES DE DETERMINATION DES SPECTRES DE NEUTRONS RAPIDES A L'AIDE DE DETECTEURS A SEUIL. (Methods for Determining Fast Neutron Spectra Using Threshold Detectors). Pierre Delattre (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1961. 105p.

31797 (CF-60-3-12(Suppl.)) PRELIMINARY HOT SPOT ANALYSIS OF THE HFIR. Neil Hilvety (Oak Ridge National Lab., Tenn.). Sept. 18, 1961. Contract [W-7405-Eng-26]. 23p.

The hot spot analysis procedure was revised to include new correlations for heat transfer coefficient and burnout heat flux. Based on these new correlations and current HFIR design data, the calculated maximum hot spot conditions (not including blister effects) are as follows: bulk water temperature 236°F; water film drop 108°F; oxide–water surface temp. 344°F; maximum heat flux 1.52×10^6 Btu/hr-ft^2; burnout heat flux 3.49×10^6 Btu/hr-ft^2; and maximum possible oxide-metal surface temp. 576°F. Calculations show that, at 100 Mw operation with a 900 psi nominal (±10%) inlet pressure, the presence of 0.05 inch diameter blisters in the 10 mil thick meat portion of the plate will be sufficient to raise the hot spot heat flux to one-half the calculated burnout value. A 0.094 inch diameter blister in the 30 mil thick meat region will produce the same reduction in burnout margin. An investigation of the effect of local fuel segregation area size and degree of segregation indicates that a 5% increase in local heat flux will result from an increase in fuel concentration of 20% over a 58 mil diameter area, or from a 10% concentration increase over a 111 mil diameter area. (auth)

31798 (LAMS-2623) ULTRA HIGH TEMPERATURE REACTOR EXPERIMENT (UHTREX). Quarterly Status Report for Period Ending August 20, 1961. (Los Alamos Scientific Lab., N. Mex.). Sept. 1961. Contract W-7405-Eng-36. 19p.

The UHTREX reactor is discussed under the topics of reactor control, core heat transfer, kinetic behavior, reactor facility (Turret), shielding, coolant system, gas cleanup system, and fuel recycle. Experiments on separation of U from fissium solutions and from Zr are reported. (D.L.C.)

31799 (NASA-TN-D-475) SOME NUCLEAR CALCULATIONS OF U^{235}–D_2O GASEOUS-CORE CAVITY REACTORS. Robert G. Ragsdale and Robert E. Hyland (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Oct. 1961. 31p.

Nuclear characteristics are analyzed for a spherical cavity reactor with a gaseous U^{235} core surrounded by a region of hydrogen gas and enclosed by an external D_2O moderator reflector. Critical masses for moderator thicknesses of 50, 100, and 200 centimeters are obtained from a one-dimensional, six-group diffusion analysis. Curves are presented to show the effects on critical mass of: shrinking the fuel region within the cavity, adding a zirconium structural wall between moderator and fuel regions, and moderator heating from 70° to 180°F. Thermal flux distributions are shown. Fully reflected cylindrical models are analyzed with a two-dimensional code. (auth)

31800 (NDA-2116-2) SPONGE FUEL EVALUATION. Quarterly Technical Report for the Period Ending June 30, 1959. J. M. McKee (Nuclear Development Corp. of America, White Plains, N. Y.). Aug. 15, 1959. Contract AT(30-1)-2303. 25p.

Uranium powder, packed in a tube and infiltrated with sodium, is proposed as a promising fuel for nuclear power reactors. A two-year program for the experimental evaluation of this fuel, termed "sponge," is described. Technical progress during the first quarter consisted mostly of capsule design calculations and drawings. Fabrication of two control consoles was started. Natural uranium shot was obtained for out-of-pile tests. Sponge fuel showed a higher reactivity than U-10% Mo in both thermal and fast sodium-cooled reactors and a slight gain in breeding ratio in the latter. (auth)

31801 (NDA-2116-3) SPONGE FUEL EVALUATION. Quarterly Technical Report for Period Ending September 30, 1959. J. M. McKee (Nuclear Development Corp. of America, White Plains, N. Y.). Dec. 4, 1959. Contract AT(30-1)-2303. 11p.

Fabrication and assembly of the first two irradiation test capsules is about 60% complete. These will test two sizes of unalloyed 3% enriched uranium shot at controlled central temperatures of 1100 and 1400°F to a burnup of 1.25 at.%. The two control consoles are 90% complete. Construction of a vacuum distillation box for use during examination of the irradiated specimens is in progress. Packing tests with unalloyed natural uranium shot showed that a mixture of particle sizes in the range of 20 to 200 mesh (33 to 3 mils diameter) can be packed to 76% of solid metal density. In these sizes the shot is not pyrophoric and can be handled in air. Equipment for making sponge fuel specimens was assembled. Filling and sealing techniques are being developed on natural uranium specimens. Fabrication of 3% enriched sponge fuel specimens in niobium containers has just begun. The basic design parameters of sponge fuel elements for the SGR, EFFBR, and EBR-II were calculated as a function of the fuel density, thermal conductivity and central temperature of the sponge. The resulting designs were used to estimate the fuel cycle costs in the SGR and EFFBR for sponge fuel in comparison with present fuels. It appears that sponge fuel will be economically attractive if the assumed thermal conductivity, central temperature, and burnup can be realized. Savings are expected mainly in fabrication costs, due to larger (and hence fewer) elements and to simpler fabrication operations. (auth)

31802 (NP-10233) SYMPOSIUM ON THE INSTRUMENTATION AND CONTROL OF NUCLEAR REACTORS HELD IN GLASGOW, MARCH 25 AND 26, 1961. (Institution of Electrical Engineers. Scottish Centre, Glasgow). 174p.

Eleven papers are included which were presented at the symposium. The papers cover a broad spectrum of topics dealing with instrumentation and control; a few deal with specific reactors, e. g., Dounreay Fast Reactor and DIDO Reactors. Separate abstracts were prepared for all eleven papers. (D.L.C.)

31803 (NP-10233(p.1-34)) OPERATIONAL EXPERIENCE ON DOUNREAY FAST REACTOR. J. Allen ([United Kingdom Atomic Energy Authority. Development and Engineering Group, Dounreay, Caithness, Scotland]).

The Dounreay Fast Reactor is described in some detail and the steps involved in its commission discussed. Experience gained in the operation of the reactor is presented under the following headings: liquid metal circuits, zero-energy physics experiments, and shut-down. The reactor instrumentation is discussed. (D.L.C.)

31804 (NP-10233(p.35-47)) THE INSTRUMENTATION OF THE DOUNREAY FAST REACTOR. R. Smart (United Kingdom Atomic Energy Authority. Development and Engineering Group, Dounreay, Caithness, Scotland).

Instrumentation of the Dounreay Fast Reactor is discussed under the following headings: control room; neutron flux measurements; control rod position; liquid metal flow, level, pressure, temperature, and oxidation measurements; fuel element damage detection; steam plant; safety and alarm systems; and transfer function analyzer. (D.L.C.)

31805 (NP-10233(p.48-60)) MODIFICATIONS TO THE INSTRUMENTATION OF THE DOUNREAY EXPERIMENTAL MATERIAL TESTING REACTOR. A. L. Whitwell (Scott (James) (Electronic Engineering) Ltd., Glasgow).

Modifications to DMTR instrumentation which were put into effect are discussed together with proposed modifications. A desk console was set up at a distance from the main instrument panels to facilitate observation and operation of instruments. Existing instrumentation will also be rearranged. Possibilities for further improvements are discussed, including a trip sequence monitoring system and more compact instrumentation. (D.L.C.)

31806 (NP-10233(p.61-4)) OBSERVATIONS RESULTING FROM THE OPERATIONAL EXPERIENCE IN D.M.T.R.

The instrumentation aspects of the DMTR, particularly the control system instrumentation, are discussed from the operator's point of view. (D.L.C.)

31807 (NP-10233(p.65-78)) KINETIC BEHAVIOUR OF FAST REACTORS. D. C. G. Smith ([United Kingdom Atomic Energy Authority. Development and Engineering Group, Dounreay, Caithness, Scotland]).

The behavior of a reactor following a perturbation is due to nuclear constants and to reactivity feedback from thermal and mechanical property variations. The effects of nuclear constants on reactor kinetics and the components of reactivity feedback are discussed. The calculation and measurements of fast reactor reactivity coefficients are considered, and the effects of various feedback types on reactor performance are outlined. (D.L.C.)

31808 (NP-10233(p.79-97)) THE HUMAN FACTOR IN CONTROL ROOM DESIGN. H. D. Howse (General Electric Co., Ltd., Erith, Kent, England).

A study was made on the human factors involved in the design of nuclear power station control rooms and long-term recommendations presented. It is stated that monitoring should be a machine function, while man's role should be that of decision-maker and last-resort safety device. A fairly compact three-man control room is proposed. It is also proposed that predictive information on the consequences of contemplated control actions be supplied by a computer which could perform other tasks, e.g., training, calculations, etc. (D.L.C.)

31809 (NP-10233(p.135-48)) AN INTRODUCTION TO THE CONTROL OF NUCLEAR REACTORS. R. C. Wheeler (United Kingdom Atomic Energy Authority. Development and Engineering Group, Dounreay, Caithness, Scotland).

A treatment of reactor control theory is presented which considers neutron life cycles of fast and thermal reactors and various possible methods of control. The essential features of a control system are discussed with some reference to the Dounreay Fast Reactor, and the kinetic equations for low-power operation are described and their application considered for a few special cases. (D.L.C.)

31810 (NP-10233(p.149-67)) A THERMAL REACTOR CONTROL SYSTEM.

A control system for thermal reactors is discussed in some detail. The degrees of reactor shutdown possible are outlined, and the Hobson-AERE control system designed for DIDO and similar reactors is described in some detail. (D.L.C.)

31811 (NP-10233(p.168-74)) APPLICATION OF MAGNETIC AMPLIFIERS TO REACTOR CONTROL. J. A. Purdie (Bruce, Peebles & Co. Ltd., Edinburgh).

A low-frequency power supply system for use with reactor control rod motors is described which uses magnetic amplifiers for power generation. The signal to the amplifiers is derived from a small synchronous link transmitter. A push-pull circuit is used to obtain reversible d-c output. (D.L.C.)

31812 (NP-10735) CALCULATIONS OF LATTICE PARAMETERS AS A FUNCTION OF THE IRRADIATION FOR A HEAVY WATER MODERATED REACTOR WITH CYLINDRICAL FUEL ELEMENTS. P. E. Ahlström and B. Tollander. Nov. 14, 1960. (RFR-85; RFN-10). PART II. P. E. Ahlström and B. Tollander. Jan. 19, 1961. (RFR-103; RFN-11). PART III. P. E. Ahlström, B. Almgren, and B. Tollander. Apr. 28, 1961. (RFR-124; RFN-15). PART IV. B. Tollander and P. E. Ahlström. Aug. 24, 1961. (RFR-147; RFN-18). (Aktiebolaget Atomenergi, Stockholm). 166p.

Formulas and operating instructions are described for three "BURN-UP" programs for the Ferranti Mercury computer, which are designed to calculate the isotopic composition of the fuel and the lattice parameters of the cell as a function of the irradiation of the fuel. In "BURN-UP 3" formulas were introduced for calculating the fast fission factors, and an option for internal determination of the step length in the Runge-Kutta integration sequence. Generalized calculations were made for the U-238 effective resonance integral. The calculations of geometrical quantities were extended to include different types of fuel rod clusters. (B.O.G.)

31813 (NUMEC-P-60) DEVELOPMENT OF PLUTONIUM BEARING FUEL MATERIALS. Progress Report, January 1 through March 31, 1961. (Nuclear Materials and Equipment Corp., Apollo, Penna.). Apr. 21, 1961. Contract AT(30-1)-2389. 38p.

Three Pu preparations were made and partially characterized. These preparations were one pure PuO_2 preparation via the batch-oxalate route and two PuO_2–UO_2 preparations containing 0.5 and 20 at.% PuO_2 via the continuous coprecipitation route. The PuO_2 preparation, which had the largest surface area of the preparations (29 m^2/g), tended to pick up weight when exposed to the box atmosphere. Dry pressing and sintering studies were conducted on the PuO_2

preparation. The results indicate that the sintered density of PuO_2 pellets is independent of green density above 5.6 and 6.0 g/cm^3 for pellets sintered at 1600 and 1400°C, respectively. Preliminary reactor physics calculations for near-thermal reactors indicate that extremely long core lives can be attained with a fuel of initial composition 78 at.% Pu^{239}, 12 at.% Pu^{240}, and 10 at.% Pu^{241}, and that the reactivity variation during core life is nominal. (D.L.C.)

31814 (ORNL-3152) RADIOACTIVITY OF NUCLEAR REACTOR COOLING FLUIDS. J. C. Ward (Oak Ridge National Lab., Tenn.). Oct. 4, 1961. Contract W-7405-eng-26. 120p.

Thesis submitted to Univ. of Oklahoma.

Methods were developed for analysis of cooling water for impurities, radioisotopes, etc., and experimental results are presented for the ORNL Research Reactor. The theory of nuclear reactions in a water-cooled reactor is discussed at length, and equations were developed which allows predictions of equilibrium conditions from nonequilibrium measurements. The equations were verified experimentally by work on the ORNL Research Reactor and can be extended to other reactors. The origins of Na^{24}, Cd, and fission product activities are discussed, and the possibility of fuel element rupture detection by delayed neutron measurements is considered. (D.L.C.)

31815 (ORO-474) FUEL CYCLE DEVELOPMENT PROGRAM MONTHLY NEWSLETTER, JUNE 1961. (National Carbon Co., Fostoria, Ohio). Sept. 8, 1961. Contract AT(40-1)-2560. 15p.

The fabrication of fueled graphite cylinders containing pyrolytic carbon-coated UC_2 particles in a graphite matrix (MTR-48-5) is described. High-temperature (1800 to 2150°C) observations are presented which indicate that uranium in carbon has a high mobility at temperature below the melting point of UC_2. (D.L.C.)

31816 (TID-8200(4th Rev.)) NUCLEAR REACTORS BUILT, BUILDING, OR PLANNED IN THE UNITED STATES AS OF JUNE 30, 1961. (Division of Reactor Development, AEC). 32p.

This compilation contains information about facilities built, being built, or planned in the United States as of June 30, 1961, which are capable of sustaining a nuclear chain reaction. Certain projects relating to military systems are not listed in detail because of their classified nature. Information is presented in five parts, each of which is categorized by primary function or purpose: civilian, military, production, export, and critical facilities. (auth)

31817 (TID-12617) GLASS BEARING FUELS. Notes from the Meeting Held at the United States Atomic Energy Commission Headquarters Building, Germantown, Maryland. (Atomic Energy Commission, Washington, D. C.). Jan. 31, 1961. 12p.

Information presented at a Meeting on Fuel Bearing Glass is summarized. Topics covered include investigations of radioactive fuel materials in glasses, glass fibers containing fissionable and fertile materials, fuel bearing fiberglas in aluminum-base fuel elements, plutonium-bearing glasses, compositional aspects of high-uranium-content glasses, glassy materials for potential nuclear fuels and control materials, and molten phosphate reactor fuels. (M.C.G.)

31818 (TID-13441) TESTS ON GAS SPACE REFLECTIVE INSULATIONS. (Orenda Engines Ltd., Malton, Ont.). Nov. 1960. Includes Supplement 1: Feb. 1961. For Oak Ridge National Lab. (Nuclear-30 and Suppl. 1) 118p.

Results are presented from tests on reflective insulations for use in gas cooled reactor coolant ducts. Reflective insulation restricts heat flow by enclosing gas in narrow vertical gas spaces thus inhibiting convection and restricting heat flow to that by gas conduction and radiation, and by reducing radiation heat flow by using the gas convection inhibiting shields as reflectors. The program was divided into two stages. The object of the first stage was to obtain thermal conductivity data for helium in some existing gas space insulation configuration, and to discover whether heat transfer performance of gas space insulations with helium could be predicted from relevant established non-dimensional correlations. The object of the second stage was to establish thermal conductivity data for ORNL reflective insulation configurations. Test data were to cover sufficient range and be of sufficient accuracy for use in reactor loop design. Data are presented on the seven configurations tested. Results indicate that the ORNL arrangement was suitable for He, but not entirely suitable for CO_2. With He, low pressure results for gross thermal conductivity were within the range of 0.15 to 0.21 BTU/ft hr deg F at pressures of 100 psia or less. An increase of up to 35% is observed with increase of pressure from 50 to 1000 psia. Tests on a control gas space configuration produced values for thermal conductivity of He approximately 10% lower than that generally accepted. This could be taken as an indication that all thermal conductivity values presented in this report are approximately 10% low. In CO_2, gross thermal conductivity increases from 0.06 to approximately 0.3 BTU/ft hr deg F with an increase of pressure from 50 to 1000 psia. (auth)

31819 (WAPD-PWR-TE-90) XENON TRANSIENT TEST. DLCS-1560303. Lawrence H. Kemmet (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Sept. 29, 1961. Contract AT(11-1)-GEN-14. 11p.

The third performance of DLCS 15603, Xenon Transient Test, was evaluated. The test was performed to determine the control rod drive speeds which are necessary for satisfactory reactor control during a burnout of maximum xenon and to determine the effect of xenon concentration on the core operating characteristics and the instrumentation system from maximum xenon to equilibrium xenon. (M.C.G.)

31820 THE THERMOSIPHON AS A NITROGEN CRYOSTAT FOR OPERATION IN THE HORIZONTAL REACTOR CHANNEL. L. Bewilogua and R. Knöner (Technische Hochschule, Dresden). Cryogenics, 2: 46-7(Sept. 1961). (In English)

A two-phase closed circuit was developed according to the thermosiphon principle to allow cooling of samples which are arranged at a large distance or are located at points of difficult access, even in cases of considerable heat supply. A temperature of 80°K was attained at a distance of 2 m using nitrogen. This temperature could be maintained for a long period even under unfavorable conditions, such as heat supply of up to 500 W, poor insulation, and partial evaporation of the external cooling liquid. (auth)

31821 ADVANCES IN NATURAL URANIUM–GRAPHITE NUCLEAR REACTORS. Tanguy and Bacher (CEA, Saclay, France). Énergie nucléaire, 3: 176-85(May-June 1961). (In French)

The advances made in the technology of natural uranium–graphite reactors are summarized by a study of the main characteristics of these systems. The problems presented by the development of these reactor systems (neutron, thermal, technological, and fuel stability to high temperature and irradiation are reviewed. The solutions found to

some of these problems are indicated, and possible future development of the natural uranium–graphite system is discussed. (J.S.R.)

31822 DETERMINATION OF EFFECTIVE AGE OF FISSION FRAGMENTS. K. K. Aglintsev. Radiokhimiya, 3: 237-9(1961). (In Russian)

A graphical method for determining the effective age of fission products and the irradiation time of uranium in a reactor, based on a correlation of the isotopic compositions of two different elements, is described. The Ce^{141}/Ce^{144} and Sr^{89}/Sr^{90} ratios were used. (R.V.J.)

31823 SEMINAR ON ANALOGUE METHODS IN NUCLEAR ENERGY PROBLEMS, ACTES–PROCEEDINGS, BRUSSELS, APRIL 21-23, 1960. Brussels, Presses Academiques Europeennes, 1961. 144p.

Eighteen of the twenty-five papers presented at the seminar are included. About half are in English, the rest are in French. Separate abstracts were prepared for seventeen, the lone exclusion being a paper outlining current nuclear analog work in the Central Electricity Generating Board of the UK. (T.R.H.)

31824 THE MULTI-POINT SIMULATION OF A NUCLEAR REACTOR. D. L. Booth, B. E. Cunio, G. V. Greatorex, and T. O. Jeffries (Atomic Power Div., English Electric Co. Ltd., Whetstone, Leics., Eng.). p.24-33 of "Seminar on Analogue Methods in Nuclear Energy Problems, Actes–Proceedings, Brussels, April 21-23, 1960." Brussels, Presses Academiques Europeennes, 1961. (In English)

The reduction of the neutron diffusion equation to a form suitable for spatial simulation of a reactor is discussed, together with the associated representation of the fuel and moderator heat transfer equations for a gas-cooled, graphite moderated system. The accuracy of the finite difference method of solving the equations is assessed and some results of the transient variation in axial flux shapes obtained from a four-point model are given for various fault conditions. The implications of the need to use such methods of simulation in terms of analog computing hardware are discussed. (auth)

31825 STUDY OF TEMPERATURE DISTRIBUTION IN REACTOR FUEL ELEMENTS. G. Renard (Centre National de la Recherche Scientifique, Paris) and E. de Robert. p.34-7 of "Seminar on Analogue Methods in Nuclear Energy Problems, Actes–Proceedings, Brussels, April 21-23, 1960." Brussels, Presses Academiques Europeennes, 1961. (In French)

Research on the temperature fields within a reactor fuel element is an essential element in the study of a reactor. The fuel element is in effect made up of different parts (uranium, cladding, end plugs, made of materials different from the mechanical or thermal point of view. The resolution of such a problem is complicated by several things: the phenomenon is governed by a Poisson equation (conduction equation with internal thermal power; the complexity of the geometry; and varying physical coefficients. One method is especially well suited to the problem, the resistance network method. It allows rapid study of numerous cases by modification of the shape and the physical coefficients. There is also the possibility of tracing precisely the temperature fields by relating them to the nodes of a compact grid. (T.R.H.)

31826 SOME APPLICATIONS OF ANALOGUE COMPUTERS IN ATOMIC POWER RESEARCH. Toshio Kawai (Hitachi Central Research Lab., Japan), Tsutomu Kanai, Takeo Miura, and Mamoru Suzuki. p.38-50 of "Seminar on Analogue Methods in Nuclear Energy Problems, Actes–Proceedings, Brussels, April 21-23, 1960." Brussels, Presses Academiques Europeennes, 1961. (In English)

Some applications of the Hitachi Low Speed Analog Computer to problems in atomic power research are presented which include computations of linear and nonlinear simultaneous differential equations and of two-point boundary value problems. They are: 1) Transient temperature distribution in a fuel rod during reactivity accidents, 2) Axial Power and void distribution in BWR, 3) Stability of the control systems of power reactors, 4) Pressure response to the change of loading in PWR, 5) Start-up of a British-type power reactor, and 6) Behavior of an ion accelerated in the oscillating magnetic field. (auth)

31827 METHODS OF CALCULATION OF KINETICS AND TEMPERATURES OF NUCLEAR REACTORS. R. Vichnevetsky (Calcul Electronic Associates Inc., France). p.51-7 of "Seminar on Analogue Methods in Nuclear Energy Problems, Actes–Proceedings, Brussels, April 21-23, 1960." Brussels, Presses Academiques Europeennes, 1961. (In French)

A treatment with the analog viewpoint is presented of two problems: 1) the problem of the choice of the cell dimensions in the finite difference technique for study of the thermics and neutronics of a reactor, and 2) the mode technique for study of control and kinetics of reactors. (T.R.H.)

31828 THE NUCLEAR REACTOR SIMULATOR AND THE ASSOCIATED THERMAL PLANT SIMULATOR. M. D. Ajnbinder (Minneapolis-Honeywell Regulator Co., Philadelphia). p.58-70 of "Seminar on Analogue Methods in Nuclear Energy Problems, Actes–Proceedings, Brussels, April 21-23, 1960." Brussels, Presses Academiques Europeennes, 1961. (In English)

The fundamental requirements for a nuclear reactor simulator are discussed and the principal circuits described. Applications of such simulators to the fields of research, teaching and applied technology are indicated. A power plant simulator can be coupled very readily to the nuclear reactor simulator. The influence of the load variations in the power plant on the behavior of the nuclear reactor simulator can be clearly seen and evaluated. Finally a description is given of teaching experience obtained with this equipment. (auth)

31829 ANALOGUE STUDY OF THE AXIAL DYNAMICS IN A GAS/GRAPHITE REACTOR. A. Facchini (AGIP Nucleare, Milan and Centro di Studi Nucleari E. Fermi, Politecnico, Milan) and V. Gervasio. p.71-7 of "Seminar on Analogue Methods in Nuclear Energy Problems, Actes–Proceedings, Brussels, April 21-23, 1960." Brussels, Presses Academiques Europeennes, 1961. (In English)

In natural U–graphite reactors, Xe poisoning and moderator positive temperature coefficient cause deformations and instabilities in neutron flux. A mathematical model for these phenomena is set up for an analog computer. A cylindrical reactor is studied, the thermal power varying slightly allowing linearization of the neutron kinetic equations. Short term effects only will be considered as a first approximation. Flux and temperature are functions of height from the bottom and time, reducing the spatial problem to a slab geometry. Temperatures can be calculated even for large variations. The equations extend to the case of long-term Xe effects. (T.R.H.)

31830 SOME RESULTS OF THE THEORY OF REACTOR DYNAMICS. Henri B. Smets (Massachusetts Inst. of

Tech., Cambridge). p.78-84 of "Seminar on Analogue Methods in Nuclear Energy Problems, Actes—Proceedings, Brussels, April 21-23, 1960." Brussels, Presses Academiques Europeennes, 1961. (In French)

When the reactivity of a nuclear reactor is related to the power by a linear function, $k = k_0 - \int_0^\infty K(u)n(t-u)du$, the dynamic behavior of the reactor depends on the value of the core K(t) and the inserted reactivity k_0. If the Laplace transform of K(t) is real and positive, the reactor is asymptotically stable regardless of the initial conditions of k_0. If K(t) is not negative [$K(t) \geq 0$], the power of the reactor is asymptotically stable if $k_0 \leq 0$ and is always limited if $k_0 > 0$, independently of the initial conditions. These properties permit a complete discussion of the essential properties of stability of nuclear reactors in which the retroaction of power is characterized by two time constants [$K(t) = r_1a_1e^{-g_1t} + r_2a_2e^{-g_2t}$]. (tr-auth)

31831 SOME REMARKS ON THE WAYS OF SIMULATING REACTOR KINETIC EQUATIONS. Ir. J. van Eenennaam (Reactor Centrum, Netherlands). p.85-90 of "Seminar on Analogue Methods in Nuclear Energy Problems, Actes—Proceedings, Brussels, April 21-23, 1960." Brussels, Presses Academiques Europeennes, 1961. (In English)

A short summary is given on the different ways in which the kinetic behavior of a reactor core may be simulated. The knowledge of the kinetic behavior of a reactor core plays an essential part in the study of possible hazards and in the synthesis of reactor control systems. For completeness' sake mention is made of the origin of the kinetic equations, which are valid for different types of reactors. These equations are analyzed, and the values of the various coefficients are given. The usual approximation (i.e., $K(1-\beta) - 1 = \delta k - \beta$; $K \approx 1$) is made. Further, different types of analog computers are discussed; with operational amplifiers as well as with passive networks, for calculations on linear scale. For the computation on log scale only an analog with operational amplifiers is described. Finally a few results of calculations are given. (auth)

31832 THE USE OF ANALOGUES IN UNIVERSITY STUDIES OF NUCLEAR REACTORS. J. C. Cluley and D. Jakeman (The University, Birmingham, Eng.). p.91-102 of "Seminar on Analogue Methods in Nuclear Energy Problems, Actes—Proceedings, Brussels, April 21-23, 1960." Brussels, Presses Academiques Europeennes, 1961. (In English)

The analog computing equipment used in the teaching of nuclear science and engineering to post-graduate students in the University of Birmingham is described. The major items are two reactor kinetics simulators, the first a commercial product, and the second a relatively inexpensive machine built in the Department of Electrical Engineering. The main features of the two simulators are described, the second in more detail, including the circuits dealing with neutron kinetics, thermal effects, and xenon poisoning, and examples of their use are given. Both of the simulators compute the time variations of the reactor state, averaged over the entire volume. As a complement to this an electrical spatial flux simulator using many of the components of the kinetic simulator has been constructed which enables the variation of flux along one dimension of the reactor to be determined under steady state conditions. The reactor can consist of up to four zones having positive or negative buckling. Also described is a technique using the analogy between neutron flux and the temperature within a solid body, which enables the flux distribution within a reactor to be investigated. This technique is particularly valuable for examining reactor systems having a complex geometry, and for determining the reactivity taken up for various configurations of control rods. A short description is given of other analog techniques which are used for teaching, such as passive electrical networks and the electrolytic tank. (auth)

31833 ANALOGUE STUDIES OF THE BOILING HEAVY WATER REACTOR IN HALDEN. H. Schmidl (Institutt for Atomenergi, Halden, Norway). p.116-23 of "Seminar on Analogue Methods in Nuclear Energy Problems, Actes—Proceedings, Brussels, April 21-23, 1960." Brussels, Presses Academiques Europeennes, 1961. (In English)

In order to study the dynamics of this reactor, the analog computing methods are used. At first the block diagram similar to the Reactor plant is developed and the different reactivity feedbacks for void and temperature are obtained. At the present time it is not possible to find exact enough the constants for the transfer function. In order to see the influence of an error one of the void coefficients at ±20% is changed. Several input disturbances exist, for instance the reactivity or the heavy water steam mass flow. Finally, as an answer, the frequency and the transient response for the nuclear power which are shown in some diagrams. (auth)

31834 USE OF ANALOG COMPUTER FOR THE DETERMINATION OF THE LONG-TERM REACTIVITY OF A GAS—GRAPHITE REACTOR. P. Basso, V. Gervasio, and C. Passarini (AGIP Nucleare, Milan). p.131-6 of "Seminar on Analogue Methods in Nuclear Energy Problems, Actes—Proceedings, Brussels, April 21-23, 1960." Brussels, Presses Academiques Europeennes, 1961. (In French)

Calculation of long-term reactivity is a problem which requires the resolution of a system of ordinary differential equations. One can thus use an analog computer. It is doubtful that such a technique has ever been used since digital computers are preferred because this type of problem demands too great a precision in the calculation to end up with a final result largely approximative. Such a problem has been taken up by the research division of AGIP Nucleaire using an Electronic Associates 231 R computer. With appropriate caution one can attain satisfactory results useful for calculation of a project, realizing at the same time a remarkable saving of time in comparison to the use of a digital computer. The system of equations solved is given along with a brief indication of the nature of the problem. The analog scheme used is also given along with indications of the choice of scale and the techniques adopted for simple and automatic setting-up of the problem in the different cases in practice. Finally, the presumed size of the error is established and in this way it is pointed out that numerical methods were used on partial results to obtain a better determination of the final result. (tr-auth)

31835 GENERAL PROBLEMS POSED FOR THE ANALOG RESOLUTION OF KINETIC EQUATIONS OF NUCLEAR REACTORS. Claude Caillet (Commissariat a l'Energie Atomique, Saclay, France). p.137-44 of "Seminar on Analogue Methods in Nuclear Energy Problems, Actes—Proceedings, Brussels, April 21-23, 1960." Brussels, Presses Academiques Europeennes, 1961. (In French)

An attempt is made to point up the utility of analog techniques in solving the kinetic equations for nuclear reactors. The reasons for the ever-increasing use of electronic machines by physicists and engineers in this area are cited. The technological problems are studied which involve ranges of values taken by the different nuclear parameters. In each case, the existence of a compromise which leads to an optimum precision is shown. The results

obtained are compared to those obtained by arithmetic computers and a critical analysis is made of the possibilities offered by the two methods of calculation. (T.R.H.)

31836 FUEL ELEMENT FOR NUCLEAR FISSION REACTORS AND PROCESS FOR THE MANUFACTURE THEREOF. (to Deutsche Gold-und Silber-Scheidenstalt Vormals Roessler). British Patent 877,065. Sept. 13, 1961.

A reactor fuel element is designed which prevents diffusion of fission products out of the element into the reactor, resulting in contamination of the reactor. The element is in the shape of a moderator structure with recesses filled with fissile material, and inhibition of diffusion is accomplished with carbon black, carbides, or nitrides, which can be formed on the element by impregnation or evaporation. (D.L.C.)

31837 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR FUEL ELEMENTS. Terence Cecil Gilbert Martin and James Duncan Waters (to United Kingdom Atomic Energy Authority). British Patent 877,111. Sept. 13, 1961.

A reactor fuel element is designed comprising a cluster of sheathed fuel rods. The fuel rods are made to form a rigid structure by uniting fins on each rod with fins on adjacent rods, and the cluster is supported in a graphite sleeve fitted with metal end rings which are held in place by metal rods. (D.L.C.)

31838 IMPROVEMENTS IN AND RELATING TO SLURRIES FOR USE AS BREEDING MATERIALS IN NUCLEAR REACTORS. Allan Brown and Anthony Chitty (to General Electric Co., Ltd.). British Patent 877,337. Sept. 13, 1961.

A method is presented for preparing slurries of ThO_2 in liquid Bi. The method comprises dissolving Th in liquid Bi and reacting the dissolved Th with an oxide, e.g., Bi_2O_3, to form ThO_2 internally in the liquid so that it is intrinsically wetted. (D.L.C.)

31839 IMPROVEMENTS RELATING TO A METHOD OF MANUFACTURING PLATES HAVING HIGH NEUTRON CAPTURE CROSS-SECTION CHARACTERISTICS AND IMPROVEMENTS IN NUCLEAR REACTOR CONTROL RODS INCLUDING SUCH PLATES. (to Babcock & Wilcox Co.). British Patent 877,370. Sept. 13, 1961.

A method is given for manufacturing casing strips or plates of high neutron capture cross sections and suitable for use in reactor control systems. The method comprises drilling spaced holes in a metal strip, filling the holes with high neutron absorbing material, closing off the holes with plugs, and rolling the plate to form the final product. The product may be joined to form a control rod of cruciform cross section. (D.L.C.)

31840 NUCLEAR PROPELLED VEHICLE, SUCH AS A ROCKET. (to U. S. Atomic Energy Commission). British Patent 877, 392. Sept. 13, 1961.

A simple nuclear rocket is described which uses a series of atomic bomb explosions for propulsion. The rocket houses a plurality of atomic bombs and has means for ejecting the bombs in sequence and detonating them at a selected distance from the rocket. The base of the rocket is covered with plastic sheets which are heated by the explosions, resulting in an explosive expansion and consequent further propulsion. (D.L.C.)

31841 IMPROVEMENTS IN FUEL ARRANGEMENTS FOR USE IN NUCLEAR REACTORS HAVING VERTICAL CHANNELS. Roger Emile Martin (to Commissariat a l'Energie Atomique). British Patent 877,418. Sept. 13, 1961.

A fuel arrangement is designed for the mounting and supporting of tubular slugs in reactor fuel channels. The arrangement comprises a multiplicity of supporting rods disposed through the tubular slugs and superimposed one on another so that each of the rods supports those above it and is supported by those under it. The tops and bottoms of the rods form swivel joints, and anti-vibration springs are mounted on the cooling fins of the fuel cans. (D.L.C.)

31842 IMPROVEMENTS RELATING TO FUEL CHARGING AND DISCHARGING APPARATUS FOR A NUCLEAR REACTOR. Winnett Boyd, John Arthur Paget, and Vernald Gilbert Lynn (to Winnett Boyd Ltd.). British Patent 877,423. Sept. 13, 1961.

A fuel charging and discharging apparatus is designed for a horizontally fueled, closed-circuit gas-cooled power reactor. The apparatus comprises working machinery and an elevator pressure vessel attached to the main pressure vessel; when not in use, the machinery is retracted into the elevator pressure vessel which is then sealed off from the reactor. In use, the machinery is subjected to the gas pressure prevailing in the reactor and to the inlet gas temperature. Periscopes are provided for lining up the machinery. (D.L.C.)

31843 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Leslie Mark Wyatt (to United Kingdom Atomic Energy Authority). British Patent 877,703. Sept. 20, 1961.

An improved reactor fuel element of the cluster type is designed which makes reductions in the amounts of sheath and structural materials possible. The fuel element has its sheath material integral with the supporting structure and shaped to accept the free ends of fuel members of an adjacent cluster. (D.L.C.)

31844 IMPROVEMENTS IN OR RELATING TO ELECTRICAL WARNING SYSTEMS FOR NUCLEAR REACTORS. William Dennis Cain (to Marconi Instruments Ltd.). British Patent 877,839. Sept. 20, 1961.

An electrical warning system is designed for detecting faulty fuel in power reactor installations. The system comprises a plurality of sampling and warning systems, into each of which is fed gas sampled sequentially from each of a group of fuel channels. Timing means is provided for driving the selector at a predetermined speed in each sampling and warning system, and a master timing means controls the system so that any faulty fuel can or a motor falling out of step is identified and an alarm sounded. (D.L.C.)

31845 CONTROL ROD FOR NUCLEAR REACTORS. Henry Wilhelm Aldrin, Axel Gerhard Varne Gustafsson, Per Olle Lennart Gustafsson, Alf Alvar Hampus Johnson, and Henry Lennart Noren (to Aktiebolaget Befors). British Patent 877,844. Sept. 20, 1961.

A reactor control rod is designed which is axially movable in a tube inside the reactor. The control rod is lowered or raised by a hydraulic motor controlled by the reactor coolant. Means is provided for releasing the control rod for quick reactor shutdown. (D.L.C.)

31846 IMPROVEMENTS IN OR RELATING TO LARGE PRESSURE VESSELS, ESPECIALLY NUCLEAR REACTOR PRESSURE VESSELS. Josef Jerzy Haftke (to Babcock & Wilcox Ltd.). British Patent 878,122. Sept. 27, 1961.

A description is given of the design and fabrication of a large spherical pressure vessel of which for greater

strength the lower portion of the shell is dished and bottom supported. An internal structure is located within the shell and it is bottom supported. An example of such a pressure vessel is that of a gas cooled graphite moderated reactor having a core of such size and weight that the dimensions of the shell required to accommodate it are large. The pressure vessel shell is fabricated by butt-welding, and the internal structure is also attached to the shell by the butt-weld process. (N.W.R.)

31847 IMPROVEMENTS IN NUCLEAR REACTORS. Anthony James Taylor (to Babcock & Wilcox Ltd.). British Patent 878,123. Sept. 27, 1961.

The supports on which the core rests within a pressure vessel of a gas cooled reactor are described. The support means include beams distributed about a center, extending radially inward to radially outward locations, and having their greatest depths at intermediate locations in their lengths. The beams are themselves supported at these intermediate locations. The beams are connected at their inner ends to the periphery of a common member of circular or polygonal form. The place of support of each of the beams is 0.65 from the center, or approximately 0.65 of the core radius. (N.W.R.)

31848 NUCLEAR REACTOR CONTROL. (to U. S. Atomic Energy Commission). British Patent 878,332. Sept. 27, 1961.

A control rod drive system including a combination of electromechanical, hydraulic, and pneumatic force producing means for moving the control rod relative to the neutron field is described. The drive means affords regulation of the control rod position during ordinary operation of the reactor. The drive means is also effective to automatically scram the control rod, in response to a predetermined neutron level in the reactor, independently of the operation of the electromechanical and hydraulic force producing means in the system. A schematic diagram of the system is presented. (N.W.R.)

31849 NEUTRONIC REACTOR STRUCTURE. Farrington Daniels (to U. S. Atomic Energy Commission). U. S. Patent 3,005,764. Oct. 24, 1961.

A reactor core, comprised of vertical stacks of hexagonal blocks of beryllium oxide having axial cylindrical apertures extending therethrough and cylindrical rods of a sintered mixture of uranium dioxide and beryllium oxide, is described. (AEC)

31850 DENSITY CONTROL IN A REACTOR. John Marshall, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,005,765. Oct. 24, 1961.

A reactor is described in which natural-uranium bodies are located in parallel channels which extend through the graphite mass in a regular lattice. The graphite mass has additional channels that are out of the lattice and contain no uranium. These additional channels decrease in number per unit volume of graphite from the center of the reactor to the exterior and have the effect of reducing the density of the graphite more at the center than at the exterior, thereby spreading neutron activity throughout the reactor. (AEC)

Power Reactors

Refer also to abstracts 30343, 30345, 30349, 30350, 30352, and 30828

31851 (ACNP-6102) PATHFINDER ATOMIC POWER PLANT TECHNICAL PROGRESS REPORT, OCTOBER 1960–DECEMBER 1960. (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). Apr. 15, 1961. Contract AT(11-1)-589. 151p. For Northern States Power Co. and Central Utilities Atomic Power Associates.

Technical progress on the research and development program being performed in connection with the design of the Pathfinder Atomic Power Plant is reported. Studies on fuel material cladding, bonding, and irradiation testing, heat transfer and fluid flow, fuel element manufacturing research and development, nuclear handling tools, low-enrichment superheater fuel element, vessel and structures, recirculation system, control rods, guide tube, control rod drives, reactor physics, reactor and system dynamics, critical experiments, and initial stability and performance tests are discussed. (M.C.G.)

31852 (ANL-6290) PREPARATION OF ALLOY FOR FIRST CORE LOADING OF EBR-II. Donald C. Hampson (Argonne National Lab., Ill.). Aug. 1961. Contract W-31-109-eng-38. 17p.

The alloy used for the fabrication of the fuel pins for the first core loading of the second Experimental Breeder Reactor (EBR-II) was prepared in the prototype equipment developed for the melt-refining processing of the irradiated EBR-II fuel. One hundred and twenty-five 10-kg ingots were made, of which 40 were unenriched uranium–fissium alloy and 85 were enriched uranium–fissium alloy. In addition, nineteen 10-kg batches of unenriched uranium–fissium scrap and forty-seven 10-kg batches of enriched uranium–fissium alloy scrap were melted for consolidation into ingots. The average yield for the alloy preparation runs was 96.5% and for the scrap remelt runs was 93%. The chemical and isotopic compositions of the ingots produced were all within specifications (95 ± 1.0 wt % uranium, of which 48.1 ± 1.2 wt % is U^{235}). (auth)

31853 (ANL-6395) U. S. PARTICIPATION IN THE OEEC HALDEN REACTOR PROJECT, MAY 1959 TO SEPTEMBER 1960. Leonard W. Fromm, Jr. (Argonne National Lab., Ill.). Dec. 1960. Contract W-31-109-eng-38. 68p.

The Halden Boiling Water Reactor, located in Halden, Norway, is an experimental process steam producer using D_2O as moderator and coolant. The reactor was first brought to criticality on June 29, 1959. A low-power, low-temperature physics program with two core loadings has been completed. Mathematical models of the reactor and plant have been developed and used in an analog computer study of dynamic behavior. Engineering activities have included design and procurement of a second core of Zircaloy-2-clad, 1.5% enriched UO_2 to replace the first core of aluminum-clad, natural uranium metal; system modifications for 20-Mw operation; a proposed replacement of the reactor vessel with a design better suited for future programs; correction of low-temperature pitting corrosion of first core fuel elements; and improvement of the cavern containment. An initial first-core power run with boiling at 2 Mw was made on October 5, 1960. (auth)

31854 (APAE-91) STEADY STATE AND TRANSIENT THERMAL AND HYDRAULIC ANALYSIS OF SM-2; TERMINATION REPORT. I. Segalman and P. L. Bradley (Alco Products, Inc., Schenectady, N. Y.). Sept. 8, 1961. Contract AT(30-3)-326. 84p.

Thermal characteristics of the SM-2 core were analyzed at steady state and loss of flow conditions. For steady state operation, the steady state code STDY-3 was used. For transients during a loss of flow acident, ART-02, a one-dimensional code, was used. This analysis indicated the

SM-2 core is safe from burnout under steady state operation at design power level (28 Mw(t)) because no nucleate boiling exists, and the minimum burnout ratio is above 2.0. The core is safe from burnout under loss of flow transient because the minimum burnout ratio in the hottest element channel of 1.82 is above the minimum design criteria of 1.5. (auth)

31855 (BAW-1203(Vol.II)) NUCLEAR MERCHANT SHIP REACTOR PROJECT; EXTENDED ZERO POWER TESTS: NS SAVANNAH CORE I. Final Report. R. M. Ball, C. E. Barksdale, M. L. Batch, J. W. Cure, J. P. Farrar, R. N. Kubik, R. H. Lewis, A. L. MacKinney, J. H. Mortenson, T. G. Pitts, S. W. Spetz, and H. J. Worsham (Babcock and Wilcox Co. Atomic Energy Div., [Lynchburg, Va.]). July 1960. 873p. Contract AT(30-1)2534.

The activity of manganese alloy wires exposed in the reactor core was measured and used in a computer program which tabulated the data and calculated the average activity for each wire and for the core. Input, operating instructions, and output are given. (M.C.G.)

31856 (BAW-1203(Vol.III)) NUCLEAR MERCHANT SHIP REACTOR PROJECT; EXTENDED ZERO POWER TESTS: NS SAVANNAH CORE I. Final Report. R. M. Ball, C. E. Barksdale, M. L. Batch, J. W. Cure, J. P. Farrar, R. N. Kubik, R. H. Lewis, A. L. MacKinney, J. H. Mortenson, T. G. Pitts, S. W. Spetz, and H. J. Worsham (Babcock and Wilcox Co. Atomic Energy Div., [Lynchburg, Va.]). July 1960. Contracts AT(30-1)2534 and B&W Contract 596-3044. 303p.

Additional computer data obtained in the extended zero power tests in which the activity of manganese alloy wires exposed in the reactor core was calculated are presented. (M.C.G.)

31857 (CEND-89) STABILIZATION OF POWER DISTRIBUTION THROUGHOUT FUEL LIFETIME WITH EMPHASIS ON REACTORS WITH INTEGRAL SUPERHEAT. C. J. Hansen (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). June 1960. Contract AT(11-1)-795. 43p.

The question of gross power shifts due to fuel burnup in multiregion reactors is of particular interest in reactors with integral nuclear superheat. It would seem desirable to build into the reactor a self-regulating system of power distribution control which would require a minimum of external control. The feasibility of such a program is discussed and various methods are examined in terms of initial core parameters whereby the program may be made practicable. (auth)

31858 (CF-61-3-9) THORIUM BREEDER REACTOR EVALUATION. PART 1. FUEL YIELD AND FUEL CYCLE COSTS IN FIVE THERMAL BREEDERS. L. G. Alexander, W. L. Carter, R. H. Chapman, R. W. Kinyon, J. W. Miller, and R. Van Winkle (Oak Ridge National Lab., Tenn.). May 24, 1961. Contract (W-7405-eng-26). 240p.

The performances of aqueous-homogeneous (AHBR), molten-salt (MSBR), liquid-bismuth (LBBR), gas-cooled graphite-moderated (GGBR), and deuterium-moderated gas-cooled (DGBR) breeder reactors were evaluated in respect to fuel yield, fuel cycle costs, and development status. A net electrical plant capability of 1000 Mwe was selected, and the fuel and fertile streams were processed continuously on-site. The maximum annual fuel yields were 16, 7, 4, 4, and 4.5%/yr respectively at a fuel cycle cost of 1.5 mills/kwhr. The minimum estimated fuel cycle costs were 0.9, 0.6, 1.0, 1.2, and 1.3 mills/kwhr at fuel yields of 7, 1, 1, 2, and 3 %/yr. At a fuel yield of 4%/yr, the costs were 0.9, 0.9, 1.5, 1.5, and 1.3 mills/kwhr. Only the AHBR and the MSBR are capable of achieving fuel yields substantially in excess of 4%/yr, and therefore, in view of the uncertainties in nuclear data and efficiencies of processing methods, only these two can be listed with confidence as being able to satisfy the main criterion of the AEC long-range thorium breeder program, viz. a doubling time of 25 years or less. The development effort required to bring the various concepts to the stage where a prototype station could be designed was estimated to be least for the AHBR, somewhat more for the MSBR, and several times as much for the other systems. The AHBR was judged to rank first in regard to nuclear capability, fuel cycle potential, and status of development. (auth)

31859 (CVNA-56) HAZARDS ANALYSIS, CVTR IN-PILE LOOP EXPERIMENT. C. Dishman (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). May 1960. Contract [AT(30-1)-2289]. 137p.

A hazard analysis is presented for a CVTR in-pile loop experiment for testing a CVTR prototype pressure tube assembly under simulated CVTR operation conditions. (D.L.C.)

31860 (DP-645) HEAVY WATER MODERATED POWER REACTORS. Progress Report, July 1961. R. R. Hood and L. Isakoff, comps. (Du Pont de Nemours (E. I.) & Co. Atomic Energy Div., Wilmington, Del.). Sept. 1961. Contract AT(07-2)-1. 27p.

At the end of July 1961, construction of the HWCTR was about 80% complete, the reactor vessel was in place, and the Hazards Evaluation Report was submitted to AEC. Satisfactory performance was exhibited in Savannah River irradiations of three thin-walled tubes of Zircaloy-clad unalloyed uranium metal; one tube reached the highest exposure yet achieved by thin-walled metal elements. Further buckling measurements were made on clusters of 0.5-inch-diameter rods of natural uranium oxide in D_2O moderator. Addition data were obtained on heat transfer burnout with elements in subcooled water at pressures as high as 1000 psia. (auth)

31861 (GEAP-3794) PLAN FOR VBWR STABILITY EXPERIMENT. W. H. Cook, J. A. Hodde, C. L. Howard, and R. O. Niemi (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Aug. 30, 1961. Changed from OFFICIAL USE ONLY Sept. 21, 1961. Contract AT(04-3)-189. 33p.

Stability tests to be made on the VBWR are described. The tests are of three types: steady state measurements, rod oscillator tests, and transient tests. The tests will be repeated at a variety of operating conditions to cover variations in the following parameters: reactor power, recirculation flow rate, pressure drop in the external piping, and core bypass leakage. The objectives of the reactor tests are outlined. (M.C.G.)

31862 (HPR-13) H.B.W.R. QUARTERLY PROGRESS REPORT, JANUARY TO MARCH 1961. (Norway. Institutt for Atomenergi. OEEC Halden Reaktor Prosjekt). 88p.

Plant operations, research activities, and engineering programs at the Halden Boiling Reactor are reported. The research activities include measurements of the static and dynamic reactor parameters, and irradiation experiments. Engineering programs include: design of plant modifications; fuel studies; and shielding and health physics activities. In-pile and out-of-pile instrumentation is described. (T.F.H.)

31863 (HW-6743) STEAM COOLED POWER REACTOR EVALUATION— BELOYARSK (URAL) REACTOR.

(General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 1961. 157p.

A study of the Beloyarsk Station design was conducted to evaluate the effects of nuclear steam superheating, as used in the Soviet design, on the economics of electric power production if such a design were used in the U. S. Russian claims were checked where possible, and accepted if they appeared reasonable in cases where no check could be made. (J.R.D.)

31864 (IDO-28573) ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM. Semiannual Progress Report, January 1–June 30, 1961. (Aerojet-General Nucleonics, San Ramon, Calif.). Aug. 10, 1961. Contract AT(10-1)-880. 164p.

The work performed January through June 1961 in connection with the Army Gas-Cooled Reactor Systems Program is summarized. The Program includes the Gas-Cooled Reactor Experiment, and the ML-1, a prototype mobile, gas-cooled nuclear power plant. Background information on the Gas Turbine Test Facility is also given. The status and progress of these projects is reported, as is information on associated tests and data evaluation, and the status of experimental and prototype components. (auth)

31865 (LAMS-2620) QUARTERLY STATUS REPORT ON LAMPRE PROGRAM FOR PERIOD ENDING AUGUST 20, 1961. (Los Alamos Scientific Lab., N. Mex.). Sept. 1961. Contract W-7405-ENG-36. 26p.

All basic experiments planned for the LAMPRE I startup program were completed. The tests included operation at 100 and 200 kw utilizing both normal and half coolant flow, and full flow operation at 400 kw. At each power level, transfer function measurements were made, and a continuous run of approximately 60 hr duration was carried out to determine the characteristics of the reactivity loss first observed at 50 kw. Various power demand tests were made. Fuel and container development was continued. Progress is reported in fuel reprocessing. The sodium test facility was operated continuously except for 7 shutdowns required by maintenance, inspection, and equipment modifications. (M.C.G.)

31866 (MND-M-1819) PM-1 NUCLEAR POWER PLANT PROGRAM. Quarterly Progress Report No. 8, December 1, 1960 to February 28, 1961. J. S. Sieg (Martin Co. Nuclear Div., Baltimore). Apr. 6, 1961. Contract AT(30-1)-2345. 217p.

Progress is reported regarding reactor development work, plant fabrication and assembly, and training. The PM-1 fuel element fabrication process is modified, yielding improved resistance to water damage. Analyses and tests are conducted on the reactor flow and heat transfer characteristics and zero-power operation. Analytical studies are performed concerning extrapolation of the power level of PM-type plants. (T.F.H.)

31867 (NP-10530) SEMINAR FOR THE PROMOTION OF NUCLEAR ENERGY APPLICATIONS IN SHIP CONSTRUCTION AND NAVIGATION. 2. REACTOR SESSION "NUCLEAR REACTORS FOR SHIP PROPULSION," NOVEMBER 25-28, 1959, HAMBURG, GERMANY. (Studiengesellschaft zur Förderung der Kernenergieverwertung im Schiffbau und Schiffahrt e. V., Hamburg). 268p. In English and German.

Twenty-eight papers are included. Topics discussed include the transfer of nuclear energy into electricity and heat, Zr and Zr alloys as construction and canning materials, boiling reactors in ship propulsion, gas-cooled reactors for ship steam turbine installations, circuits for saturated steam processes with organic moderated reactors, 1959 development report for NS "Savannah", design of a ship reactor cooled and moderated with organic materials, comparative study of some reactor systems for marine propulsion, economic and social aspects of nuclear energy applications, insurance questions for nuclear fuel elements in ship reactors, nuclear reactor installation for marine use, organic coolant in the OMR, comparison of nuclear merchant ship propulsion systems, commercial tankers with reactor propulsion, utilization of nuclear energy for ship propulsion in the Bund Republic, safety of power reactors, secondary shield design of a PWR for ship propulsion, the maritime gas-cooled reactor program of General Dynamics, possible reductions in operating costs during life of an organic moderated reactor for ship propulsion, radiation protection and construction materials, core arrangement of tubular fuel elements in the OMR, calculation of laminated shields by the removal cross section method, construction of reactor shielding, problems of helium turboengines for atomic installations, instrumentation problems in nuclear reactors for ship propulsion, nuclear propulsion development in Norway, and a small experimental nuclear ship. (J.S.R.)

31868 (NP-10699) SUPPLEMENTARY ANALYSIS OF THE POWER-LIMITING SYSTEM FOR THE ENRICO FERMI ATOMIC POWER PLANT. Report No. 1317. (Bendix Corp. Research Labs. Div., Southfield, Mich.). Sept. 30, 1959. For Atomic Power Development Associates, Inc. 153p.

An evaluation was made of the effects of design changes on the power-limiting system of the Enrico Fermi Atomic Power Plant. The power-limiting system is the control system designed to control large fluctuations in power whose magnitude and rate fall outside the preset limits of operation of the regulating system. The computer simulations were made for the primary coolant loop, effects of core design changes, changes in temperature coefficients of reactivity, shut-down temperature changes, hot-channel considerations, and reactor inlet coolant transients. (For initial analysis, see BAC/RL-1052.) (B.O.G.)

31869 (NP-10700) "TRANSIENT AND OSCILLATOR ANALYSIS FOR HAZARDS EVALUATION" AND "OSCILLATOR ANALYSIS FOR REACTOR STARTUP TESTS" FOR THE ENRICO FERMI ATOMIC POWER PLANT. Final Report. Report No. 1653. C. D. Taulbee, E. H. Lemon, E. B. Skuta, and C. F. Connolly (Bendix Corp. Research Labs., Div., Southfield, Mich.). Dec. 30, 1960. For Atomic Power Development Associates, Inc. and Power Reactor Development Co. 153p.

A discussion is given of the work done on the programs involved in describing the Enrico Fermi Reactor mathematically and in turn electrically on a large analog computer, then simulating various transient conditions and transfer functions to evaluate the kinetic behavior of the reactor. Many of the simulations, repetitions of similar simulations done previously, were re-evaluated because of changes in fuel-element design and full-power operating level. The simulation program is described in terms of: transient simulation runs; analysis of transient temperatures; trip-level settings; transfer function simulation results; and the simulation model. (B.O.G.)

31870 (NP-10722) NON-LINEAR ANALYTICAL METHODS IN NUCLEAR POWER REACTOR KINETICS. Henri B. Smets (Organization for European Economic Co-Operation, Paris). 1961. 80p.

Presented at the European Atomic Energy Society Symposium on Reactivity Feedback Mechanisms and Nuclear Reactor Stability, Zurich, September 25-26, 1961.

It was assumed that the kinetic behavior of a nuclear reactor at power level can be described in terms of a set of non-linear ordinary differential equations. The main results of the study of non-linear power reactor kinetics are presented with special references to the analytical non-linear methods used. A series of problems of practical interest were solved as illustration. (auth)

31871 (NYO-8753(Vol.II)(Del.)) DESIGN AND FEASIBILITY STUDY OF A PEBBLE BED REACTOR-STEAM POWER PLANT. (Sanderson and Porter, New York). May 1, 1958. Declassified with deletions Apr. 19, 1961. Contract AT(30-1)-2095. 64p.

The status of development studies being conducted on a pebble bed power reactor is outlined. The items discussed are fuel element manufacture, stability, and reprocessing, and component development. (D.L.C.)

31872 (ORO-454) ANALYSIS OF A POWER FAILURE INCIDENT FOR THE PRELIMINARY CONCEPTUAL DESIGN OF THE SMALL SIZE PRESSURIZED WATER REACTOR. Charles F. Bonilla (Gibbs and Hill, Inc., New York). Dec. 8, 1959. Contract AT(40-1)-2589. 49p.

An analysis of the conceptual design of a small pressurized water reactor was conducted to determine the effects of power failure. The analysis, in conjunction with examination of current pressurized water reactor designs, leads to the conclusion that there is no fuel element burnout hazard because of a sudden power failure for as long as water remains in the vaporizer. (J.R.D.)

31873 (SL-1873) ENGINEERING EVALUATION STUDIES HEAVY WATER MODERATED POWER REACTOR PLANTS. W. A. Chittenden and G. F. Hoveke (Sargent and Lundy, Chicago). June 30, 1961. Contract AT-(38-1)-213. 335p.

Engineering evaluation studies focused on heavy water moderated power reactor technology are discussed. Stainless steel, carbon steel, and Zircaloy-2 corrosion data are presented. Water treatment and corrosion product deposition are described. A study aimed at evaluating the effect of incorporating alternate low cost materials into a full-scale boiling D_2O direct cycle power reactor plant was made. Component design data sheets were prepared for the equipment used in the heavy water systems of projects presently in operation, under construction, or being designed. Leakage tests were made on shaft seals in the power plant equipment. Design correlation studies were carried out. A detailed comparison of the capital costs for a conventional steam power plant and the boiling D_2O, pressure tube, direct cycle plant were made. A pressure tube safety analysis was carried out. A computer program is being developed for economic optimization studies. (M.C.G.)

31874 (TID-13067) ENGINEERING EVALUATION STUDIES, HEAVY WATER MODERATED POWER REACTOR PLANTS. Quarterly Progress Report [Covering Period] January-March 1961. (Sargent and Lundy, Chicago). Apr. 25, 1961. Contract AT(38-1)-213. 217p. (SL-1829-3).

The corrosion of Inconel in D_2O under simulated D_2O-moderated power reactor conditions is measured. The in-pile and out-of-pile deposition of the corrosion products of carbon steel is determined. The performance of steel in primary system piping, as well as the performance of type 304 stainless steel, Monel, Inconel, Ni, and 70-30 Cu-Ni in the feed-water heaters are analyzed. Design data for various reactor components—steam generators, heat exchangers, valves, reactor vessels, pumps, and water-treating and fuel-handling equipment—are compared between several reactors. D_2O leakage tests on pump shaft seals and valve glands are reported. Design features of 11 D_2O-moderated reactors that are in various stages of design in the United States, Canada, and Europe are correlated. A computer program is discussed whose purpose is the economic optimization of the liquid-D_2O-cooled indirect cycle concept, the boiling-D_2O indirect cycle concept, and the boiling-D_2O direct cycle concept. (T.F.H.)

31875 (TID-13675) MONTHLY OPERATING REPORT, AUGUST 1961. Vol. IV-Issue 8. (Duquesne Light Co., Shippingport, Penna.). Contract AT(11-1)-292. 78p.

The end of Core I, Seed 2 power operation is reported. Additional power runs with this core for training were conducted. Plant refueling was completed. Reference water chemical conditions in the component cooling water system and the primary water storage tank were maintained; it is noted that fission product activities declined during the month because of reduced power operation. Health physics efforts were primarily devoted to prevention of contamination spread from 1D boiler chamber pump volute replacement. Other information is presented on routine maintenance and tests, and on construction projects. (J.R.D.)

31876 (TID-13835) S1C PROTOTYPE REACTOR FACILITY. Quarterly Environmental Monitoring Report, April—June 1960, Volume I, Number 2. (Combustion Engineering, Inc. Naval Reactors Div., Windsor, Conn.). Sept. 1960. Contract AT(30-3)-519. 7p.

Measurements of the radioactivity in the Farmington River, the industrial waste effluent from the plant, air, and fall-out, in the S1C Prototype vicinity, during the second quarter of 1960 showed no significant contribution of radioactivity from the S1C Prototype to the environment. (auth)

31877 (WCAP-4043) OPTIMIZATION OF A PRESSURE TUBE POWER REACTOR FUELED WITH NATURAL URANIUM AND USING HEAVY WATER AS MODERATOR. R. G. St. Paul (Westinghouse Electric Corp., Atomic Power Dept., Pittsburgh). Oct. 1960. 140p.

Thesis submitted to Univ. of Pittsburgh.

A study of optimization to minimize power costs is presented. Results of an analysis of factors involved in maintenance of a stable chain reaction and in the removal and use of generated heat are included. (J.R.D.)

31878 THE GAS ANALYTICAL CONTROL OF THE HELIUM CYCLE OF A HEAVY WATER REACTOR. Gunter Stockel (Siemens & Halske A. G., Karlsruhe, Ger.). Arch. tech. Messen, Lfg., 302: 65-8(Mar. 1961). (In German)

The analysis of the gas in the helium cycle of the Research Reactor FR 2 at Karlsruhe is discussed. The processes by which foreign gases get in the helium atmosphere are described. The range of measurements for the individual instruments are 0 to 5% for O_2, 0 to 4% for D_2, 0 to 4% for N_2, and 0 to 4% for N_2 plus O_2 in helium. The arrangement of the instruments is shown and the sequence in which the gases are measured is described. The mode of operation of the arrangement is outlined. The designs of the instruments are described. (M.C.G.)

31879 PROSPECTS FOR ADVANCED NUCLEAR SYSTEMS. R. V. Meghreblian (California Inst. of Tech., Pasadena). Astronautica Acta, 7: 276-89(1961). (In English)

The performance of fission reactors as power sources for

the direct heating of a propellant in a rocket engine is examined with the aid of a nontemperature limited reactor concept and a generalized engine model which includes a radiator. This means that some fissionable material is retained within the reactor in gas phase, and the incorporation of a radiator allows greater freedom in dispensing unsuitable forms of energy attenuated in the solid members of the engine. The fission reactor cannot produce limitless specific impulse if regenerative cooling by the propellant is the only mechanism for cooling the engine solids. The maximum available is about three times that possible with all solid-fuel reactors. The addition of a radiator relaxes this limit, but in these systems the thrust-to-weight ratio of the engine becomes less than unity. Application of this general model is made to both high acceleration (ground takeoff) and low acceleration (interplanetary) vehicles. The high acceleration systems are shown to yield substantial gains in payload fraction over other propulsion systems. In the low acceleration case, the ultimate fission reactor offers some reduction in trip time to the near planets; but, for the more distant planets, the nuclear-electric systems appear to be superior, unless the thermal radiation flux from the gaseous cavities is found to be smaller than anticipated. (auth)

31880 UTILIZATION OF THE PLUTONIUM FUEL CYCLE. [PART] I. Junichi Shimokawa. Genshiryoku Kôgyô, 6: No. 5, 51-5(May 1960). (In Japanese)

The Pu recycle problem is reviewed on the basis of fuel cost estimated by the Nuclear Fuel Group of the Japanese AEC. The fuel costs of the Calder Hall reactor with and without Pu recycling are compared with those of BWR under the same conditions, using an equation which takes the amount of Pu recycled and the additional cost of the Pu–U fuel element fabrication into account. It is concluded that under Japanese economic conditions in case of a converter, the "once-through" system appears to be preferable to a method involving fuel reprocessing followed by Pu recycle in view of the high fabrication cost of the U–Pu fuel elements and the loss of the Pu credit. (TTT)

31881 IMPROVEMENTS IN AND RELATING TO GAS-COOLED HETEROGENEOUS NUCLEAR REACTORS. Robert Normal Dew and Michael Carl Hartnell-Beavis (to General Electric Co., Ltd.). British Patent 877,679. Sept. 20, 1961.

An improved gas-cooled reactor is designed which has a high thermal output to volume ratio. The pressure vessel is formed with a separate point of access for each fuel channel, and the fuel channels are convergent toward the top, so that the spacing of the points of access is greater than that of the fuel channels within the core. The advantages of this arrangement are that the closer proximity of the fuel channels near the top results in an optimum axial flux distribution for heat transfer, individual standpipes are provided for each of the fuel channels, and the core size may be reduced. One disadvantage is that the fuel elements have to be inverted half-way through their life. (D.L.C.)

31882 IMPROVEMENTS IN OR RELATING TO NEUTRONIC REACTOR. (to American Radiator & Standard Sanitary Corp.). British Patent 878,097. Sept. 27, 1961.

The arrangement, design, and operation of a boiling reactor for delivering steam under pressure are described. The reactor consists of a liquid coolant which contains fissionable material and a liquid moderator separated from the coolant. The relative proportions of coolant and moderator to each other and to the amount of fissionable material are selected to provide for relative small incremental heat removal a positive steam coefficient of reactivity, under which the reactor is automatically loaded following response to steam pressure. There are means for varying the moderator level to increase the range of control and to supply a relatively large load demand while maintaining a positive steam coefficient. There are also means connected to the reactor for varying the recirculation rate of the coolant to obtain the heat removal required for large load demands. The variation of the moderator level is also effective for intermediate size incremental heat removal demands while maintaining a positive steam coefficient. (N.W.R.)

31883 NUCLEAR REACTOR. (to U. S. Atomic Energy Commission). British Patent 878,180. Sept. 27, 1961.

The design, characteristics, operation, and performance of a molten plutonium fueled fast breeder reactor are described. The reactor consists of a vessel, a core supported within the vessel and spaced in relation to the vessel, the core containing a quantity of molten plutonium-containing fuel, the quantity of plutonium in the fuel being sufficient to sustain a condition of criticality, the fuel being confined by the walls of at least one tube within the core, means including a coolant in conductive contact with the walls of the tube for removing heat from the core, and means for controlling the reactivity in the core. The fuel is supplied by injection means. The injection device includes a noncritical reservoir located external to the core. The reservoir is connected to the top and bottom of the core and has means for heating the fuel and displacing the fuel into the core by the injection means. A reflector is also provided around the core and contains coolant channels. (N.W.R.)

31884 CONTROL OF NUCLEAR POWER PLANTS. (to Sulzer Frêres, Société Anonyme). British Patent 878,436. Sept. 27, 1961.

A method is described for controlling the load on a gas cooled reactor of a nuclear power plant of the kind wherein the cooling gas supply system consists of a number of parallel connected rotary compressors adapted to be brought into and put out of operation individually. To increase the load a valve is opened in a gas supply pipe which extends to the reactor from a compressor to be brought into operation before the pressure produced by this compressor has reached the level required for positive delivery. This operation increases the delivery pressure of this compressor to the level of the pressure of the compressors already in operation. To reduce the load, the valve is closed after the delivery pressure of the compressor to be taken out of operation has dropped below the level required for positive delivery. This action stops the compressor. Adjustments may be made on the valve for varying the delivery pressure. A schematic diagram is presented of a plant employing this system. (N.W.R.)

Production Reactors

31885 (CEA-1926) LA PROTECTION CONTRE LE CO_2 DES ENSEMBLES G2 ET G3. (Protection of G2 and G3 Against CO_2). J. Rodier and J. Chassany (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1961. 26p.

The presence of 60,000 m^3 of CO_2 at 15 kg/cm^2 pressure made it necessary to set up a detection and protection system. Instruments to check CO and CO_2 in the atmosphere carry out measurements continuously, alarm systems give warning if the CO_2 content increases, and the working areas

may be surveyed by a whole series of portable instruments. (auth)

Research Reactors

31886 (BLG-59) BELGIAN ENGINEERING TEST REACTOR, BR 2, SAFETY AND DESIGN. Final Report. (Brussels. Centre d'Etude de l'Energie Nucleaire). May 1, 1961. 469p. A revision of preliminary report NDA-68-3.

A description is given of the design of the Belgian materials testing reactor, BR2, covering its mechanical design, reactor physics, control systems, auxiliary process systems, containment building, supporting facilities, administration and operating procedures, site evaluation, and safety analysis. Some of the development and research experiments leading up to the final design are summarized and critical experiments are reported in some detail. This report serves as the basis for a final hazards evaluation prior to the initial start-up. (auth)

31887 (CF-61-8-67) GC-ORR LOOP NO. 2 CHECK VALVE TESTS. F. A. Flint (Oak Ridge National Lab., Tenn.). Aug. 23, 1961. Contract [W-7405-eng-26]. 19p.

Air pressure drop and helium back-leakage tests were conducted on ball-check valves proposed for use in the GC-ORR Loop No. 2. These valves are being installed to prevent the bypassing of helium thru either of the two paralleled compressors when one is inoperative. It was concluded that incompressible-flow loss coefficients adequately describe the pressure drop characteristic over the flow range investigated and, on this basis, curves of helium pressure drop vs. flow rate and Reynold's number were calculated from the results of the air tests. At the design helium flow rate of 500 lb/hr (314.4 psia, 600°F) thru the open port, the valve has a predicted pressure drop of approximately seven inches of water. At the air flow rate which produces an equivalent pressure drop, the ball vibrates violently against its retaining cage and the walls of the valve. Back-leakage tests indicated that this vibration damages the ball surface and leads to increased leakage. However, measured leakage rates were not excessive and the valve was judged suitable for the intended application. (auth)

31888 (KAPL-M-CH-2) L-42 LOOP CONTROL VALVE FAILURE MTR REACTOR. C. W. Higby and T. R. Neville (Knolls Atomic Power Lab., Schenectady, N. Y.). May 23, 1961. Contract W-31-109-Eng-52. 8p.

The final evaluation of the L-42 loop flow control valve failure which occurred on March 2, 1961 is presented. The failure was detected when loop flow could not be established for tests during reactor shutdown. The valve plug guide bushing was found to have dropped out of the bonnet preventing flow through the valve. A replacement valve was installed and the loop returned to normal operation. (auth)

31889 (RISO-21) ON SOME BOILING PHENOMENA IN THE HOMOGENEOUS REACTOR DR 1. P. Skjerk Christensen (Denmark. Atomenergikommissionen. Forsogsinstitut, Riso). May 1961. 32p.

A discussion is given of boiling phenomena in a homogeneous reactor studied with regard to reactivity loss and heat output as a function of nuclear power, and with certain temperatures as parameters. It was proved that the boiling acts on the reactivity in the same way as the usual power-coefficient. As the boiling is undesirable, counter measures were taken to prevent this. Experiments were carried out to confirm the results of the counter-measures. (auth)

31890 (RISÖ-29) POWER MEASUREMENT AT THE DANISH REACTOR DR 2 BASED ON N^{16} ACTIVITY OF THE PRIMARY COOLANT. H. E. Kongsø, P. Z. Skanborg, and K. O. Nielsen (Denmark. Atomenergikommissionen. Forsøgsinstitut, Risø). July 1961. 23p.

At the Danish 5-Mw research reactor DR 2, a reactor power indicating instrument was developed, whose design is based upon the measurement of the N^{16} gamma activity in the light water coolant from the core. The instrument consists of a NaI(Tl) scintillation counter together with a single channel analyzer, which when adjusted to an energy of ~4 Mev measures only the high energy γ radiation from N^{16} (E = 6.1 and 7.1 Mev; $t_{1/2}$ = 7.35 sec) in the primary coolant. The instrument is equipped with a counter which in addition to indicating the reactor power level gives a direct indication of integrated reactor power in Mw-hours. By adjusting the shielding and geometry of the detector, it was possible to obtain data showing that a part of the gamma spectrum at the detector position is hyperbolic in shape. It is shown that when the single channel analyzer is measuring at this section of the spectrum, errors in the indication of reactor power due to variations in the gain of the photomultiplier and amplifier are eliminated. In addition, the influence from flow-rate upon the indication of reactor power by the N^{16} measuring instrument was eliminated over the usual variations of flow rate by proper positioning and shielding of the scintillation crystal. The operating experience with this measuring instrument proved that it gives an indication within ±1% of the power as determined from thermal measurements and for all practical purposes independent of core-configurations, control rod positions, and temperature of the primary coolant. (auth)

31891 UNIVERSITY TRAINING REACTORS IN JAPAN. (3 Articles). Yoshiteru Kuroda (Tokyo Univ.), Masaji Ishida, Teijiro Kokubo, Shinichi Sakai. Genshiryoku Kôgyô, 6: No. 11, 26-40(Nov. 1960). (In Japanese)

A description is given of the general purpose of the university training reactors (UTR), the training of scientists and engineers using UTR, and research methods and operational problems encountered with these reactors. Two types of subcritical assemblies are currently in use in Japanese universities: a subcritical assembly with a pulsed-neutron source (UO_2-H_2O—heterogeneous) at the Tokyo University and the Nuclear Fusion Experiment Device at the Tokyo Institute of Technology (natural $U-H_2O$—heterogeneous and 20% enriched $U-H_2O$—swimming pool type). University training reactors are located at Rikkyo University (Triga II type, 100 kw, 20% enriched U—ZrH—homogeneous), at Tokyo University (90% enriched UAl_4-H_2O), at Kinki University (99% enriched UAl_4-H_2O) and at the Musashi Institute of Technology (Triga II type, 100 kw, 20% enriched U). (TTT)

31892 ZED-2, CANADA'S NEWEST RESEARCH REACTOR. A. E. Foster (Foster Wheeler Ltd., Can.). Heat Eng., 36: 24-7(Mar.-Apr. 1961).

The ZED-2 reactor which will operate at a maximum of 100 watts for research into the optimum physics of fuels is described. A sectional drawing of the reactor is shown. The heavy water system, freezer-drier system, instrumentation, rod handling equipment, and graphite supply are discussed. (M.C.G.)

31893 DOUNREAY EXPERIMENTAL REACTOR ESTABLISHMENT INFORMATION BOOKLET. (United

Kingdom Atomic Energy Authority. Industrial Group. Dounreay Experimental Reactor Establishment, Caithness, Scotland). May 1961. 59p. $0.86(BIS)

Work of the five divisions which make up the Dounreay Experimental Reactor Establishment is discussed. The Dounreay Fast Reactor and the Dounreay Materials Testing Reactor are described. Experimental work on assemblies of fissile material in various shapes and sizes is outlined. The development, fabrication, and reprocessing of fuel elements is described. The responsibilities of the engineering, health and safety, and administration divisions are summarized. (M.C.G.)

WASTE DISPOSAL AND PROCESSING

31894 (CRER-1018) MOVEMENT OF RADIOACTIVE WASTE THROUGH SOIL. 3. INVESTIGATING THE MIGRATION OF FISSION PRODUCTS FROM HIGH-IONIC LIQUIDS DEPOSITED IN SOIL. P. J. Parsons (Atomic Energy of Canada Ltd., Chalk River, Ont.). Aug. 1961. 46p. (AECL-1325)

One of the disposal areas for radioactive waste from the Chalk River Project was in use from 1946 until 1955. Although this was mainly used for the burial of solid waste, three batches of liquid were fed into the soil and these caused radionuclides to percolate away from the area by the natural movement of ground water. A soil investigation was made to find the extent of this migration and a special soil sampler was developed to carry out intensive sampling in the regions neighbouring the disposal area. The investigation is described and the results interpreted to determine the total quantity of each fission product that moved, together with the present rate of advance. The migration is delineated. Sr^{90} was the radionuclide in greatest abundance and the future pattern of its movement was predicted; it was estimated that no major release from this source to the environment will occur for 150 years, when it will have decayed sufficiently to present a negligible hazard. (auth)

31895 (HW-65540) SCAVENGING AS A PREDISPOSAL TREATMENT FOR NPR DECONTAMINATION WASTES. W. N. Koop (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 7, 1960. Contract AT(45-1)-1350. 15p.

An investigation was carried out to determine which radionuclides of particular waste disposal concern would be scavenged from mixtures of Hanford Production Reactor (NPR) cleaning solution containing potassium permanganate. The procedures consisted of making up mixtures of cleaners, adding a solution of the nuclide being evaluated, storing for 4 to 6 days, centrifuging at 2000 rpm for 15 min and determining the change in nuclide concentration of a withdrawn aliquot by suitable emission counts. The measure of scavenging was calculated by dividing the counting rate for the unscavenged nuclide solution by the rate for the supernatant aliquot. Seven of the 15 radionuclides studied were effectively scavenged (>99%) from each of the three mixture combinations used. These were radioisotopes of Fe, Ca, Sr, Zr, Ba, Ce, and Zn. Scavenging decontamination factors of the order of 10^3 were obtained for radiocobalt and radioiodine from the two mixtures that did not include the "peroxide–carbonate" cleaner. In the third mixture, which included this cleaner no significant scavenging of either nuclide was detected. Radionuclides of Sb, Ru, Cs, Ag, Cr, and P were not effectively scavenged (<50%). (M.C.G.)

31896 (HW-67037) LABORATORY INVESTIGATION OF DECONTAMINATING SOLUTIONS FOR PRESENT REACTORS. J. E. Mendel (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 14, 1960. Contract W-31-109-Eng-52. 14p.

A mixture of 0.9M sulfuric acid-0.3M oxalic acid-1 g/l phenylthiorea at 60°C was the best decontamination agent tested for both aluminum process tubing and stainless steel pigtail surfaces. Decontamination factors of more than ten were achieved with ten minutes contact time. The oxide film containing the radioactive contaminants was not dissolved but only loosened from the surface. A flushing action was necessary to achieve best decontamination. The sulfuric acid–oxalic acid mixture is much less corrosive to aluminum than is Sulfur-1. However, its attack on carbon and stainless steel is quite severe, and a corrosion inhibitor must be added to protect these metals. Several corrosion inhibitors were tested which provided adequate protection. From these phenylthiourea was chosen for use. The results of tests evaluating about twenty other candidate decontaminating agents, including several proprietary cleaners, are also reported. (auth)

31897 (HW-68863) DISPOSAL OF NPR DECONTAMINATION WASTES. W. N. Koop (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 14, 1961. Contract AT(45-1)-1350. 21p.

Additional bench-scale experiments were conducted with multistep waste to determine the rate of precipitate, the sludge volume, and the soil adsorption of radionuclides remaining in the supernatant liquid until sent to a crib. Disposal of waste from a second process used in decontaminating carbon steel protions of the primary coolant loop was also investigated. A proprietary inhibited phosphoric acid was used for this. Scavenging methods studied included the precipitation of phosphate from the waste, the precipitation of ferric hydroxide and manganese hydroxide, and the precipitation of calcium aluminum phosphate. Characteristics of these three methods are summarized. (M.C.G.)

31898 (HW-69176) FIXATION OF RADIOACTIVE RESIDUES. Quarterly Progress Report, January–March 1961. D. W. Pearce, ed. (General Electric Co. Hanford Atomic Products Operation). Apr. 15, 1961. Contract AT(45-1)-1350. 43p.

Research and development activities in the field of fixation of radioactive wastes are reported. Calcination studies of simulated Purex high-level waste solutions by the batch method were continued on the bench scale. Melting of the calcine was studied with emphasis on the effects of the relative concentrations of metal ions in the waste solution. Batch calcination in annular pots using induction heating was demonstrated as was a procedure for removing the calcines for rework. A general equation was developed relating temperatures in proposed cylindrical and annular cylindrical containers full of high-activity-level calcined waste with other parameters of vessel size, heat generation rates, coolant temperatures, calcine thermal conductivity, and vessel-coolant heat transfer rates. Laboratory investigations of mineral reactions for the solid fixation of radioisotopes from wastes were continued. Studies were made of adsorbers, elution of mineral beds, evaluation of adsorption variables, and new mineral reactions. The decontamination abilities of clinoptilolite and organic ion exchange resins were explored. (M.C.G.)

31899 (HW-70768) STRONTIUM AND CESIUM LOADING CHARACTERISTICS OF DECALSO, LINDE 4A AND CLINOPTILOLITE COLUMNS. L. L. Ames, Jr. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 15, 1961. Contract AT(45-1)-1350. 13p.

The cation sieve properties of Decalso, clinopolite, and pelletized Linde 4A, were compared in laboratory column studies. Decalso was a superior cation exchange material for cesium and strontium in the absence of macro-concentrations of competing cations. Linde 4A was the most

strontium-selective, and clinoptilolite was the best exchange material for cesium. No one zeolite or exchanger was found to be a superior cesium and strontium extractor in all chemical environments. (auth)

31900 (NP-10815) STORAGE OF HIGH-LEVEL RADIOACTIVE WASTE IN UNDERGROUND SALT BED FORMATIONS. Progress Report No. 1. Shosei Serata (Michigan State Univ., East Lansing. Coll. of Engineering). Apr. 1, 1960. 16p.

A study was initiated in the fall of 1959 to investigate the feasibility of long-term storage of high level radioactive waste into cavities created in underground salt bed formations. From a preliminary study, the structural stability of the cavity in relation to a number of variables such as triaxial pressure, liquid exposure, temperature, gamma irradiation, time, and ground formation, appears to be of prime importance. Experimental procedures and devices have been developed to study the effect of these variables on the cavity. The laboratory findings will be correlated with data obtained from field studies conducted at a salt mine located in the Michigan Salt Basin. The research work thus far has been concentrated on determining the fundamental structural properties of rock salt sampled from Michigan and Kansas salt basins. The results compare favorably with rock salt sampled from Texas salt domes. (auth)

31901 (ORNL-TM-5) LOW LEVEL WASTE TREATMENT BY ION-EXCHANGE, II. USE OF A WEAK ACID, CARBOXYLIC-PHENOLIC ION-EXCHANGE RESIN. R. R. Holcomb and J. T. Roberts (Oak Ridge National Lab., Tenn.). Sept. 25, 1961. Contract W-7405-eng-26. 8p.

Laboratory results are presented for a flowsheet study of a process for decontaminating ORNL low level waste water. The water is adjusted to approximately pH 12 with NaOH, clarified, and passed through a bed of phenolic cation exchange resin. This study, using a phenolic-carboxylic resin, showed essentially the same results as those previously reported using a phenolic-sulfonic resin, i.e., radioactivities in ORNL waste were reduced to the order of 10% of MPC. The phenolic-carboxylic resin has the advantage that it can be regenerated with 0.5 M HNO_3 instead of the 5 M HCl required for the phenolic-sulfonic resin. Volume reduction factors of 2000 to 3000 were achieved. (auth)

31902 (ORO-452) REPORT ON INVESTIGATION AS TO THE ACHIEVABLE RESULTS OF RADIOACTIVE SLUDGE DEWATERING BY CONTINUOUS CENTRIFUGATION. (Dorr-Oliver Inc., Stamford, Conn.). May 1, 1961. Changed from OFFICIAL USE ONLY Sept. 8, 1961. Contract AT(40-1)-2746. 36p.

Studies were conducted on the use of the continuous centrifuge in the ORNL Process Waste Treatment Plant for dewatering sludge and removing suspended solids from the plant effluent. The effects of continuous sludge removal and recirculation on clarification efficiency were also studied. It was found that sludge can be dewatered to a concentration of 40 to 50% total solids in this way. Sludge recirculation to the flocculating basins improved the flocculation reactions and reduced the suspended solids concentration of the plant effluent by 28%. (D.L.C.)

31903 (ORO-453) FINAL REPORT OF AN INVESTIGATION ON THE DEGREE OF ACTIVITY ASSOCIATED WITH PARTICULATE SOLIDS OF DIFFERENT PARTICLE SIZE REMOVED FROM LARGE-VOLUME, LOW-LEVEL RADIOACTIVE PROCESS WASTE AT ORNL. (Dorr-Oliver Inc., Stamford, Conn.). May 1, 1961. Changed from OFFICIAL USE ONLY Sept. 28, 1961. Contract AT(40-1)-2746. 124p.

A DorrClone Separation System was constructed to determine particle size of suspended solids present in low-level radioactive wastes and their effect on activity level. The particulate matter present in raw process waste and in the effluent from the process waste treatment plant at ORNL was studied. The activity level of the separated solids was found to vary with particle size, and data are presented to show activity level-particle size relationships for gross gamma activity and for Cs^{137}, Sr^{90}, Ce^{144}, Co^{60}, Ru^{106}, and $Zr^{95}-Nb^{95}$. The activity level of the solids was $\sim 10^4$ times greater than that of the waste from which the solids were removed. (D.L.C.)

31904 (WIN-124) QUARTERLY REPORT [ON WASTE DISPOSAL], JANUARY 1, 1961–MARCH 31, 1961. (National Lead Co., Inc. Winchester Lab., Winchester, Mass.). May 1961. Contract AT(49-6)-924. 40p.

Work was continued in analytical development, U mill effluent decontamination, mill dust evaluation, leaching behavior of Ra in mill tailings, and on patterns of area contamination from mill operations. A comprehensive, though interim, topical report was written concerning area contamination near U mills. (auth)

31905 AN INCINERATOR FOR URANIUM CONTAMINATED WASTES. R. C. Thorburn and R. J. Chandler. Ind. Water & Wastes, 6: No. 2, 46-8(Mar.-Apr. 1961).

The disposal of large volumes of low uranium content wastes via the conventional means of an AEC licensed disposal company resulted in sufficient cost to justify the exploration of methods for reducing costs. Engineering studies showed that a gas fired incinerator provided with exhaust gas filters and other safeguards could reduce the volume effectively with complete safety. Such a unit was installed. After the first 28 weeks of operation the cost of the equipment and the engineering study was recovered and a net savings of $82,100 was effected. These figures are somewhat deceptive in that they include credit for the disposal of waste stored during the 10-month period while the incinerator was being tested and built. Nevertheless, the substantial savings should make this approach to waste volume reduction of definite interest to all operations with this type of problem. (Public Health Eng. Abstr., 41: No. 8, 1961).

31906 NEUTRALIZATION OF SEWAGE CONTAINING RADIOACTIVE MATTER. A. A. Kastal'skii. Zhur. Vsesoyuz. Khim. Obshchestva im. D. I. Mendeleeva, 6: 193-9(1961). (In Russian)

Various methods of sewage decontamination are discussed and various filter devices and chemicals are analyzed. (R.V.J.)

31907 PROCESSING OF RADIOACTIVE WASTE. Rudolph T. Allemann and Benjamin M. Johnson, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,006,859. Oct. 31, 1961.

A process for concentrating fission-product-containing waste solutions from fuel element processing is described. The process comprises the addition of sugar to the solution, preferably after it is made alkaline; spraying the solution into a heated space whereby a dry powder is formed; heating the powder to at least 220°C in the presence of oxygen whereby the powder ignites, the sugar is converted to carbon, and the salts are decomposed by the carbon; melting the powder at between 800 and 900°C; and cooling the melt. (AEC)

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